REPORT

ASSESSING SAFEGUARDS FOR HYDROGEN SUSTAINABILITY

In Germany's carbon contracts for difference

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Disclaimer

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SUMMARY

Germany's carbon contracts for difference mechanism, known as the Klimaschutzverträge (KSV), will be crucial in supporting the decarbonisation of its heavy industries, like steel and chemicals, through green hydrogen. This instrument, introduced in 2024, subsidises the additional costs of implementing such industrial decarbonisation projects, thereby helping Germany achieve its goals of emissions reduction, industrial competitiveness, and hydrogen leadership.

The KSV is designed to dynamically reflect changes in market prices in its annual subsidy payouts to ensure the efficiency of state funding. However, it does not fully account for the inherent risks and inefficiencies associated with hydrogen production and use. This study assesses the KSV instrument design on factors like treatment of fossil-based hydrogen, energy and resource efficiency, environmental and social safeguards, and impacts on hydrogen-exporting countries. Its key findings are summarised as follows.

Eligibility of "low-carbon" hydrogen: The German National Hydrogen Strategy (NHS) prohibits direct public funding for "low-carbon" hydrogen production, allowing support only for its use. The KSV thus keeps hydrogen production outside the funded project boundaries and focuses only on its use in industrial projects. However, this could contradict the NHS, as projects can still include hydrogen production costs in their bid prices, thus indirectly getting subsidies for "low-carbon" hydrogen production. Continued support for "low-carbon" hydrogen could delay progress towards climate goals and prolong fossil energy dependence, contradicting Paris Agreement objectives. Future KSV funding rounds should explicitly exclude direct and indirect funding of fossil-based hydrogen.

Incentives for green hydrogen: Green hydrogen was favoured in the first round of KSV funding due to its inherently lower lifecycle emissions and other cost incentives, such as the 3% dynamisation surcharge offered to green hydrogen and the base price for "low-carbon" hydrogen being set equal to the higher green hydrogen price. However, a revised draft of the KSV Funding Directive suggests removing the emissions reduction criterion for bid evaluation, diminishing the competitive advantage of green hydrogen over "low-carbon" hydrogen. We caution against this change and recommend significantly increasing the dynamisation surcharge and price risk coverage for green hydrogen and removing the price risk coverage for "low-carbon" hydrogen. We also recommend continuing to use a higher minimum emissions reduction threshold for "low-carbon" hydrogen than for green hydrogen and ensuring robust accounting of upstream emissions to signal a clear preference for green hydrogen.

Energy and resource efficiency: If all lifecycle emissions are properly accounted for, the KSV bidding mechanism that incentivises cost minimisation should be sufficient to ensure the most energy- and resource-efficient outcome. However, it is unclear whether transport emissions from upstream hydrogen used in a project are accounted for. This could lead to transport emissions and associated energy losses not being fully reflected in bid prices. We recommend explicitly accounting for emissions from transport to incentivise projects that prioritise hydrogen and derivatives produced close to the project location to the extent possible. Similarly, the bidding mechanism would also reflect the higher costs of inefficient uses of hydrogen, but this does not guarantee that such projects do not win contracts. It is thus necessary to implement additional safeguards to ensure that hydrogen is only used in projects or sectors where direct electrification is not a viable option.

Raising the bar on sustainability: Projects using hydrogen produced in Europe are automatically subject to EU environmental and social regulations. However, projects importing hydrogen could potentially avoid obtaining certifications proving compliance with these EU regulations if not explicitly obliged to do so. We recommend that Germany develop and adopt a holistic sustainability standard that not only includes environmental and social safeguards but also actively promotes value addition for local communities in hydrogen-exporting countries. The KSV Funding Directive should explicitly require all types of hydrogen, regardless of where it is produced, to comply with this holistic sustainability standard.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

BMWK	Federal Ministry of Economic Affairs and Climate Action
CCS	Carbon capture and storage
CO_2	Carbon dioxide
EU	European Union
EUR	Euro
GHG	Greenhouse gas
KSV	Klimaschutzverträge (carbon contracts for difference)
MJ	Megajoule
$MtCO_2e$	Megaton of carbon dioxide equivalent
NHS	National Hydrogen Strategy
tCO_2e	Tonnes of carbon dioxide equivalent
TWh	Terawatt hour

/Λ 01 INTRODUCTION AND BACKGROUND

The NHS defines **green hydrogen** as that which is produced from water electrolysis with renewable electricity, and **"low-carbon" hydrogen** as that which is produced with either waste or fossil gas in combination with carbon capture and storage.

The Federal Republic of Germany has identified hydrogen as a key lever for national decarbonisation and industrial transformation. It published a National Hydrogen Strategy (NHS), first in 2020, followed by an update in 2023, outlining objectives and plans for supporting, procuring, and utilising green and "low-carbon" hydrogen in line with its goal of achieving climate neutrality by 2045 (BMWK, 2023). According to the NHS and the Hydrogen Import Strategy published in 2024, Germany expects demand for hydrogen and its derivatives to reach 95-130 terawatt hours (TWh) by 2030 and 560-700 TWh by 2045, mainly in heavy industries like steel and chemicals, as well as in the transport and power sectors (BMWK, 2023, 2024f). 50-70% of this demand is expected to be met by imports, diversified from within and outside the EU to ensure the security of supply (BMWK, 2024f).

Hydrogen derivatives are defined as gaseous or liquid energy carriers and raw materials (e.g., methane, ammonia, methanol and synthetic fuels) based on green or "low-carbon" hydrogen.

Industrial decarbonisation through hydrogen involves, in many cases, deep process transformations. This requires companies to make high upfront capital investments and pay premiums for green hydrogen, which they perceive as risking competitiveness in the short term. However, investing in industrial transformation, including through green hydrogen, represents an opportunity for early movers to secure long-term competitiveness through technological innovation and supply chain development. Germany's NHS thus recognises the need to financially support the transformation of its heavy industries through hydrogen to meet its climate goals and to become a global leader in hydrogen technologies (BMWK, 2023).

In 2022, the Federal Ministry of Economic Affairs and Climate Action (BMWK) launched the **Klimaschutzverträge (KSV)** scheme to provide financial support to companies undertaking climate-friendly transformations (not only through hydrogen) in energy-intensive industries located in Germany, such as steel, glass, paper, and chemicals. The KSV contract is also called a **carbon contract for difference**, as it covers a company's additional costs (both capital and operational) of implementing a climate-friendly "transformative" project compared to the conventional "reference" system for a duration of 15 years. Every year that this cost differential is positive (i.e., the climate-friendly project is more expensive than a conventional alternative) under market conditions (i.e., effective carbon price and energy prices), the state pays a subsidy to the company. As soon as the decarbonisation project becomes cheaper than the conventional alternative, the company pays the difference to the state instead (BMWK, 2024g).

A **transformative** project or production process is defined as that which involves significant technological changes, substantial investments in new technologies, and/or a shift to climate-friendly energy sources or materials.

A **reference** system is defined as the prevailing production technology for a given industrial product at the time of funding.

KSV contracts are awarded through a competitive auctioning mechanism. Companies submit bids based on their estimated additional cost of reducing greenhouse gas (GHG) emissions through a certain project, along with the volume of emissions they expect to reduce over time. Companies with the highest emissions reduction potential and the least cost per tonne of carbon dioxide equivalent (tCO_2e) reduced win the auction. Winners are awarded 15-year contracts, wherein they commit to achieving a minimum GHG emissions reduction of at least 60% within the first three years and 90% before the last year of the contract, compared to the reference system specified at the time of funding (BMWK, 2024c).

Winning companies were Nordenham Metall GmbH, Schmiedewerke Gröditz GmbH, tesa Werk Hamburg GmbH, Papierfabrik Adolf Jass GmbH & Co. KG, and Ziegel- und Klinkerwerke Janinhoff GmbH & Co. KG.

The first round of KSV auctions was concluded in July 2024. Fifteen companies won contracts worth a total of EUR 2.8 billion. The companies expect cumulative emissions reductions of 17 megatons of carbon dioxide equivalent ($MtCO_2e$) over 15 years. Five of these companies plan to use hydrogen to decarbonise the production of steel, metals, bricks, adhesive tapes, and packaging paper. Specific details about the projects or the type of hydrogen they intend to use are not public. A preparatory phase for the second auction round was concluded in September 2024, in which 130 companies expressed interest in participating. The funding call for the second round is expected to be announced in early 2025, with the total volume of possible funding exceeding EUR 10 billion (BMWK, 2024e).

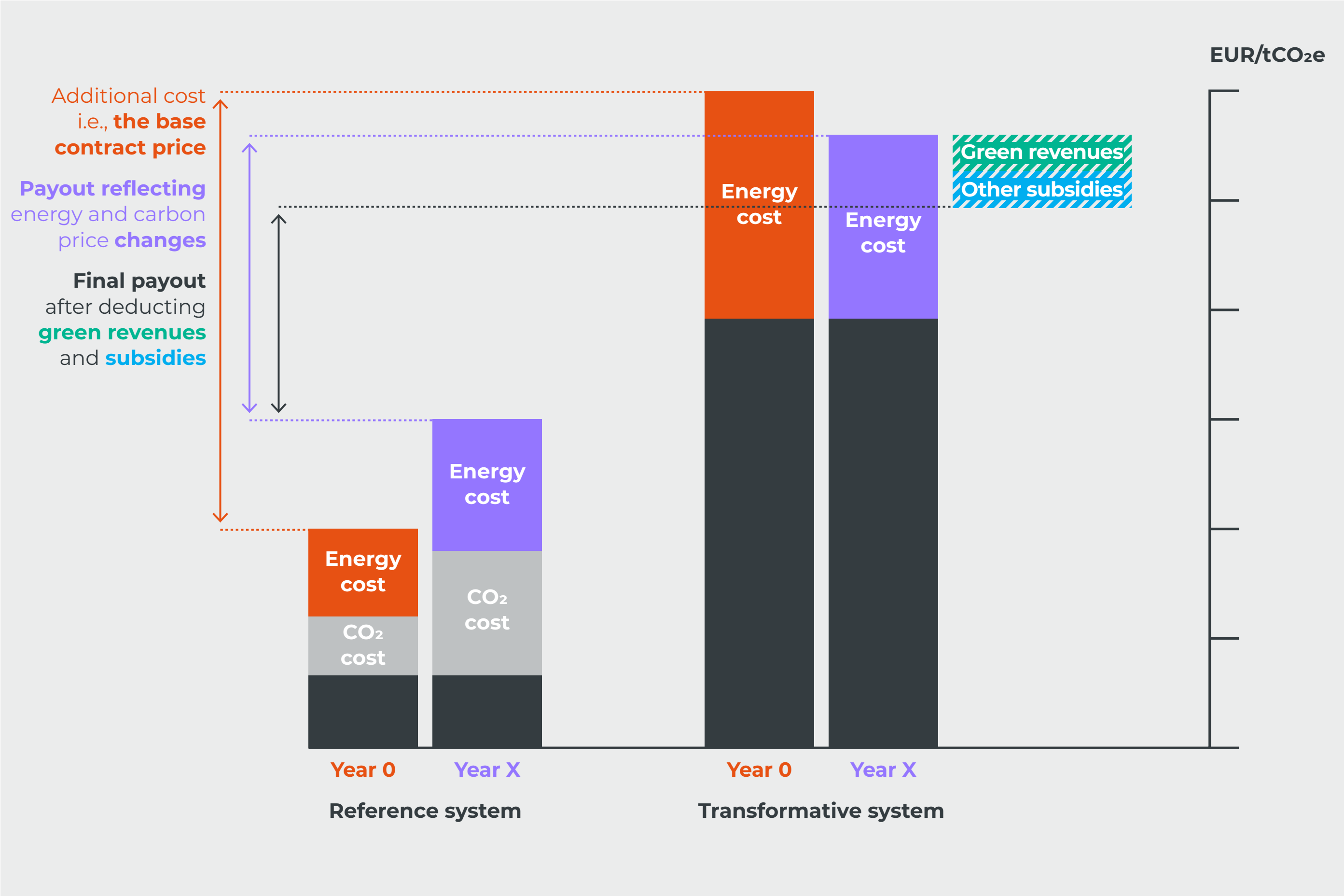
1.1 DETERMINING THE KSV PAYOUT

The **green surplus revenue** is defined as the additional revenue that the grant recipient may generate by achieving higher prices for the sale of products manufactured using the supported climate-friendly production process than for products manufactured using conventional production processes.

→ **Figure 1** provides a visual representation of the payout mechanism: Once the auction is complete and winners are chosen, the winning bid price becomes **the base contract** price for the awarded KSV contracts. The actual subsidy **amount paid out** to the contracted companies is calculated annually by adjusting the base contract price to reflect yearly changes **in energy and carbon prices** and multiplying this adjusted price by the actual emissions reduction achieved in that year. Energy and carbon price changes that reduce the company’s real additional costs of implementing a transformative project result in a deduction from the base contract price, while those that increase real additional costs lead to an upward adjustment. **Other subsidies** received by the company and a fraction of any **green surplus revenues** that the project expects to generate may be deducted from the payout to ensure that the state subsidy covers only the real gap in revenues of the transformative project (BMWK, 2024c).

The annual ex-post correction that allows the subsidy to respond dynamically to real energy price changes is called dynamisation. It enables companies to avoid factoring in the risk of energy price variability into their initial bids and prevents the lock-in of a fixed high state subsidy amount for the entire 15-year period. The dynamisation feature can be applied to energy carriers used in the reference and transformative systems at the discretion of the granting authority. Energy price changes in each system affect the annual payout differently, depending on their overall effect on the additional cost of implementing the transformative system compared to the reference system.

Fig. 1
Annual KSV payout of a transformative project reflects real changes in energy and carbon prices as well as other revenues earned by the project



The KSV Funding Directive, which sets the guidelines for the KSV scheme, also allows the option to apply a percentage dynamisation factor for energy price variability, which protects the state from the full burden of an increased payout and cushions the company against a fully reduced payout in case of energy price changes. The presence of a dynamisation factor prevents the company from taking the full decrease or increase in payout due to energy price changes. A higher dynamisation factor (i.e., closer to 100%) means the company is more exposed to the real impact of energy price variations, and a lower dynamisation factor (i.e., closer to 1%) means more of the price risk is covered by the state.

We explain these mechanisms with the help of illustrative examples **(see → Fig. 2)**. In the examples, we assume that in a winning project, the cost of the reference system is EUR 100/tCO_2e and the cost of the transformative system is EUR 300/tCO_2e in the year of contracting (Year 0). This sets the base contract price equal to the difference, i.e., EUR 200/tCO_2e for the full contract period. In any given year (Year X), the prices of energy carriers used in either system could go up or down compared to the year of contracting, causing this difference to expand or contract and be reflected in the final payout due to dynamisation. We assume the dynamisation factor was set at 60% for both systems at the time of contracting.

In **→ Figure 2 [A]**, we consider what happens if the price of the energy carrier used in the reference system goes up by EUR 50/tCO_2e and the price of that used in the transformative system decreases by EUR 20/tCO_2e in Year X. These changes reduce the real additional cost of implementing the transformative project compared to their conventional alternative, which implies lower subsidy needs for the company. Due to dynamisation, these price changes are deducted from the base contract price (EUR 200/tCO_2e), thus reducing the payout to EUR 130/tCO_2e. However, the application of the dynamisation factor means only 60% of the price differences get deducted (EUR 30/tCO_2e for the reference system and EUR 12/tCO_2e for the transformative system), thus only reducing the payout to EUR 158/tCO_2e.

In **→ Figure 2 [B]**, we consider what happens if the price of the energy carrier used in the reference system decreases by EUR 50/tCO_2e and that used in the transformative system increases by EUR 20/tCO_2e. These changes increase the real additional cost of implementing the transformative project compared to their conventional alternative, which implies increased subsidy needs for the company. Due to dynamisation, these price changes get added to the base contract price and increase the payout to EUR 270/tCO_2e. However, the application of the dynamisation factor means only 60% of the price differences get added, thus only increasing the payout to EUR 242/tCO_2e.

It is important to note that, in any case, the company is only entitled to a payout as long as the real energy price changes do not lead to the transformative project becoming cheaper than the conventional reference project. If that happens, the company becomes obligated to pay the cost differential to the state. This mechanism ensures that the state does not subsidise a project once it has become cost competitive compared to the conventional alternative.

Fig. 2

Energy price changes that decrease [A] or increase [B] the cost differential between the reference and transformative systems lead to a decreased or increased subsidy payout respectively

1.2 RATIONALE, SCOPE, AND METHOD OF THIS STUDY

Green or “low-carbon” hydrogen are likely to be the key decarbonisation options supported via the KSV for heavy industries like steel and chemicals production. The KSV mechanism can subsidise the additional costs of implementing these projects and offset the high upfront costs facing investing companies, thus providing the initial push needed to get projects off the ground.

KSV funding is agnostic to how companies procure green or “low-carbon” hydrogen for their transformative projects, that is, whether they produce it themselves or procure it from elsewhere, including imports from abroad. The KSV is required to promote projects that help build infrastructure, foster lead markets, and enhance the knowledge and expertise necessary for decarbonisation. Supported projects should involve a high level of value chain integration that fits the German government's industrial and energy strategy (BMWK, 2024c, para. 3.2). It is thus designed to achieve Germany’s simultaneous goals of cost-effective emissions reductions, industrial competitiveness, and hydrogen leadership.

There are several risks and inefficiencies associated with hydrogen production and use, which must be kept in mind while assessing the effectiveness of the KSV instrument. For example, green hydrogen is the only form of hydrogen produced and combusted without emissions, and the only form that should be financed with public money to maintain Paris-compatibility of state subsidies. Green hydrogen also involves high energy losses at every step of the value chain and requires large quantities of land and water for production. It has high potential social and environmental impacts and runs the risk of replicating extractive patterns associated with commodity trade when sourced from developing economies (NewClimate Institute, 2024). Depending on its design, the KSV instrument can have variable impacts on each of these sustainability aspects.

This study assesses the extent to which the KSV instrument is designed to account for the various risks and opportunities associated with hydrogen. These include energy and resource efficiency, environmental and social safeguards, and equitable benefits for exporting countries. This study is part of a two-part series investigating auction mechanisms supporting hydrogen development. **The corresponding paper** in the series analyses the H2Global instrument.

The assessment method followed in this study is based on the Sustainable Development Impact Matrix developed as part of a former report by NewClimate Institute titled Green Hydrogen for Sustainable Development (NewClimate Institute, 2024). The Matrix defines the specific conditions under which green hydrogen value chain development could have desirable or undesirable impacts on several social, economic, and environmental aspects of sustainability. We adapted and built on this Matrix to develop a checklist of standards applicable to the assessment of financial instruments like the KSV **(see → Annex)**.

During the assessment, we reviewed unofficial English translations of KSV documents published by the BMWK and cross-checked our findings with the original German versions. These documents include the KSV Funding Directive, which sets the rules and guidelines for how KSV funding can be disbursed, and the first funding call, which provides specific information on how the first auction was structured (BMWK, 2024c, 2024b). We also reviewed the new draft of the Funding Directive released for public consultation from 6 December 2024 to 17 January 2025 to point out the key changes proposed that would impact the findings in this study (BMWK, 2024d). European Union (EU) regulations or other national-level strategy documents were consulted only when explicitly referenced in one of the aforementioned sources. Other secondary sources were consulted on an ad hoc basis.

The next section presents key findings from this assessment, followed by recommendations to improve the effectiveness and sustainability of the KSV instrument.

/Λ 02 KEY FINDINGS

This section describes our key findings with regard to the effectiveness and sustainability of the support of hydrogen through the KSV. One key concern beyond the KSV is the inclusion of fossil-based hydrogen in Germany's overall approach to hydrogen. Incentivising fossil fuels contradicts the required transition to meet the temperature limit of the Paris Agreement and risks locking in infrastructure in the oil and gas sector. Against this backdrop, we focus our assessment on how the potential support of "low-carbon" hydrogen via the KSV poses risks to meeting the objectives of the Paris Agreement **(see → Section 2.1, → Section 2.2, and → Section 2.3)**. We also identify gaps in terms of the efficiency of hydrogen procurement and utilisation **(→ Section 2.4)**, and the social and environmental sustainability of hydrogen imports **(→ Section 2.5)**.

2.1 "LOW-CARBON" HYDROGEN PRODUCTION CAN BE FUNDED DUE TO A LEGAL LOOPHOLE, CONTRADICTING THE NHS

The German National Hydrogen Strategy (NHS) permits public support for using "low-carbon" hydrogen in a ramp-up phase but prohibits supporting its production. Though the KSV officially only supports projects using "low-carbon" hydrogen (in addition to green hydrogen), it contradicts the NHS by implicitly supporting projects that produce it. This is possible due to a loophole regarding the definition of funded project boundaries in the KSV Funding Directive.

The KSV Funding Directive defines "system boundaries" of a funded project to include all steps involved directly in the production process of an industrial product, including the production of intermediate products that are converted into the final industrial product (BMWK, 2024c, para. 2.20). Energy inputs used in the process (such as electricity or secondary energy carriers like hydrogen) do not qualify as intermediate products, and their production would thus be outside the boundaries of a funded project (BMWK, 2024c, para. 2.28). Production of hydrogen derivatives can be included within system boundaries as long as they are not converted back to energy but directly used in the manufacture of an industrial product (e.g., ammonia used to produce fertilisers) (BMWK, 2024c, para. 4.5). Such project boundaries are ostensibly in place to ensure that the KSV only covers the additional costs of industrial projects as mandated and does not subsidise projects in the energy sector.

Thus, the KSV concerns itself only with the parts of a project that involve using hydrogen for industrial application, regardless of whether the project produces its own hydrogen or procures it from elsewhere. The only qualifying requirement for the hydrogen used is that it should meet the definitions of "green" or "low-carbon" hydrogen as mentioned in the KSV Funding Directive **(see → Section 2.2)** (BMWK, 2024c, para. 4.9). This reflects the objectives described in the NHS, which permits the provision of state support for the use of both types of hydrogen as necessary in the market ramp-up phase (BMWK, 2023).

However, the costs for the supply of hydrogen can be included in the bid price: Projects that involve investing in "low-carbon" hydrogen manufacturing facilities are bound to reflect these additional capital and operational costs in their bid prices (BMWK, 2024a, pt. 013). If such projects end up winning contracts, the state subsidy would effectively cover these additional costs and, by extension, subsidise the production of "low-carbon" hydrogen while being able to maintain the legal claim that this was outside the boundaries of the funded project. Artificially cutting out hydrogen production from project boundaries potentially creates a loophole that allows KSV funding to go to "low-carbon" hydrogen production, thus violating the NHS mandate to restrict direct financial support for green hydrogen production only.

This loophole could have eventually been addressed by the provision in the KSV Funding Directive that requires future funding calls to restrict the use of “certain types” of hydrogen and derivatives in compliance with the NHS once the EU Directive on renewable gases, natural gas, and hydrogen markets enters into force (BMWK, 2024c, paras 2.6, 4.9). With this EU Directive (2024/1788) effective since August 2024, after the first KSV funding round ended in July 2024, subsequent rounds should comply with the NHS intention to provide direct state financial support only to green hydrogen or to support “low-carbon” hydrogen only in the market ramp-up phase (BMWK, 2023). However, the new public consultation draft of the KSV Funding Directive removes all language around aligning funding with the NHS, thus leaving room for the KSV to continue funding projects relying on “low-carbon” hydrogen indefinitely (BMWK, 2024d, para. 2.10).

Direct and indirect public support for "low-carbon" hydrogen fundamentally undermines the objectives of the Paris Agreement by perpetuating fossil fuel dependence. The NHS and KSV aim to prevent fossil fuel lock-in within industrial sectors by not supporting “low-carbon” hydrogen production. However, allowing public support for its use is counterproductive as it creates prolonged demand for fossil energy and strengthens supply-side lock-in, thus delaying Germany's broader climate transition. By allowing the import of fossil-based hydrogen, Germany would nominally progress towards its national climate goals while supporting fossil fuel industries in other countries, effectively exporting responsibility for fossil fuel phaseout. Moreover, “low-carbon” hydrogen involves higher lifecycle emissions than green hydrogen due to the production and transport of fossil fuels required in its manufacture, and these emissions are not all properly counted **(see → Section 2.2)**. Continued reliance on fossil-based hydrogen, even if it claims to be “low-carbon”, is not a Paris-compatible pathway and should not be supported.

2.2 STANDARDS FOR “LOW-CARBON” HYDROGEN ARE DECLINING WITH THE PROPOSED DRAFT REGULATION

The KSV Funding Directive sets clear definitions for “green” and “low-carbon” hydrogen based on emissions and sustainability standards. It defines green hydrogen as that which is made from water electrolysis using renewable electricity and demonstrates 70% lifecycle GHG emissions reduction relative to a fossil fuel comparator. Similarly, it defines “low-carbon” hydrogen as that which is made from either fossil fuels or bioenergy sources and demonstrates 73.4% lifecycle GHG emissions reduction relative to a fossil fuel comparator, presumably using an emissions abatement technology like carbon capture and storage (CCS).

Lifecycle emissions are all the emissions associated with the production and use of a specific product, from cradle to grave, including emissions from raw materials, manufacture, transport, storage, sale, use and disposal.

It is positive that the emissions reduction threshold for "low-carbon” hydrogen is based on lifecycle emissions and set at a more stringent 73.4%, surpassing the standard for green hydrogen. This higher benchmark effectively raises the bar for fossil-based hydrogen to qualify as "low-carbon," acknowledging the greater lifecycle emissions associated with fossil fuel production, transportation, and utilisation.

However, there is no standardised EU-level methodology for calculating emissions from "low-carbon" hydrogen. A draft of the Delegated Act pursuant to Article 9(5) of the EU Directive 2024/1788, which mandates the development of such a methodology, was released for public consultation in September 2024 (EU, 2024; European Commission, 2024). This draft proposed using a default value for upstream and midstream methane emissions, drawing criticism for not adequately reflecting the emissions contributing a significant share of the GHG emissions associated with fossil-based hydrogen (DUH, 2024; T&E, 2024). Even if this uniform methodology is amended and adopted, it will still be difficult to fully account for methane emissions arising from fossil gas production and transport due to unreliable emissions data across the supply chain (DUH, 2020).

Until the methodology specific to “low-carbon” fuels is in place, the KSV proposes applying the accounting methodology used for renewable fuels (as under EU Delegated Regulation 2023/1185) to account for emissions from “low-carbon” hydrogen (BMWK, 2024d, para. 2.10). This stopgap measure also does not address upstream methane emissions, allowing projects using “low-carbon” hydrogen to avoid accountability and more easily meet the minimum emissions reduction threshold to be eligible for KSV funding.

The KSV Funding Directive also sets additional requirements for defining green and “low-carbon” hydrogen. Green hydrogen must demonstrate compliance with EU Delegated Regulation 2023/1184, which sets rules for additionality, temporal correlation, and geographical correlation. These requirements ensure that green hydrogen leads to the installation of new and additional renewable power capacity, supports the integration of renewables into the electricity grid, and does not burden the electricity grid (PtX Hub, 2023). “Low-carbon” hydrogen, on the other hand, must demonstrate avoidance of significant adverse impacts on other environmental objectives as per the EU Delegated Regulation 2021/2139. This Regulation sets out detailed technical criteria to evaluate whether hydrogen value chain activities impact marine resources, biodiversity and ecosystems, waste generation, circular economy, and pollution (EU, 2021).

The new public consultation draft of the KSV Funding Directive proposes changes to the way “low-carbon” hydrogen is defined. In a positive step, it amends the definition of “low-carbon” hydrogen to exclude hydrogen produced from bioenergy sources, categorising this under the definition of "biomass" instead (BMWK, 2024d, para. 2.9). Consequently, projects using hydrogen made from bioenergy would be subject to the funding rules governing the use of biomass. These rules require the project to prove that its energy needs could not have been viably met with direct electrification and to ensure that the biomass used comes from residual or waste materials, is scalable in supply, and complies with various sustainability regulations applicable at the EU level (BMWK, 2024d, para. 4.10). This change would align the treatment of hydrogen produced from bioenergy with the stricter standards applied to biomass use within the EU.

Other proposed changes to the definition of “low-carbon” hydrogen, which now only refers to fossil-based hydrogen, are not as positive. It reduces the minimum threshold for lifecycle emissions reduction for “low-carbon” hydrogen from 73.4% to 70%, aligning it with the requirement for green hydrogen and lowering the emissions standard for “low-carbon” hydrogen (BMWK, 2024d, para. 2.10). Additionally, the public consultation draft removes language around “low-carbon” hydrogen having to comply with EU environmental objectives as per EU Regulation 2021/2139, thus diluting the explicit environmental sustainability obligations as well **(see → Section 2.5)**. Allowing “low-carbon” hydrogen to be publicly funded through the KSV is already out of line with the Paris Agreement objectives, as described in **→ Section 2.1**. Diluting the emissions and sustainability standards applied to it lowers the bar even further.

2.3 GREEN HYDROGEN WAS FAVOURED IN THE FIRST ROUND, BUT INCENTIVES ARE CHANGING

The KSV Funding Directive specifies two criteria for scoring and evaluating bids – funding cost efficiency (based on the base contract price and cost efficiency of other subsidies) and relative GHG emissions reductions achieved in the first five years (BMWK, 2024c, para. 8.3(d)). The two criteria are individually scored, weighted, and multiplied to result in a total composite score for each bid. The lower the bid price or base contract price and the higher the relative GHG emissions reduction of a project, the greater its total score and the more likely it is to be awarded.

Green hydrogen already performs better than “low-carbon” hydrogen on the relative GHG emissions component of the score. This is because “low-carbon” hydrogen would have higher lifecycle emissions than green hydrogen even if both meet the minimum emissions reduction threshold, for example, due to the risk of pipeline methane leakages or imperfect storage of captured carbon. If funding cost efficiency were equal, this would automatically give the edge to projects relying on green hydrogen over those using “low-carbon” hydrogen. In addition, features of the KSV Funding Directive and the first funding call introduced differences in how green and “low-carbon” hydrogen prices are dynamised. This may have impacted how different projects calculated their bid prices, in turn giving green hydrogen a further edge on the funding cost efficiency component of the score as well.

This is due to the dynamics created by two separate incentives. Firstly, the Funding Directive allows projects using green hydrogen to add a 3% surcharge on top of its real indexed energy prices used to calculate annual payouts (BMWK, 2024c, para. 7.2e). This acts as a buffer against real changes in green hydrogen prices, ensuring the payout is 3% higher than it would have been otherwise **(→ Fig. 3)**. This buffer serves to reduce the payout variability for projects using green hydrogen, allowing them to bid lower and be more competitive in the auction.

Fig. 3

Impact of a decrease [A] or increase [B] in the real indexed price of green hydrogen on annual subsidy payouts, in the presence of the 3% surcharge and 90% dynamisation factor

Secondly, the base price for both types of hydrogen was set equal to the higher price of green hydrogen in the first funding call. This makes the initial cost of a transformative project using "low-carbon" hydrogen much higher than it would have been if its real base price had been used, thus increasing its additional costs compared to the reference system and, in turn, inflating its bid prices. This also means that "low-carbon" hydrogen projects can be certain of getting their annual payouts reduced, as the real indexed price of "low-carbon" hydrogen is always going to be lower than the base price of green hydrogen **(→ Fig. 4)**. Anticipating a consistently reduced payout can cause companies to further inflate their bids, thus making them even less competitive in the auction against projects using green hydrogen.

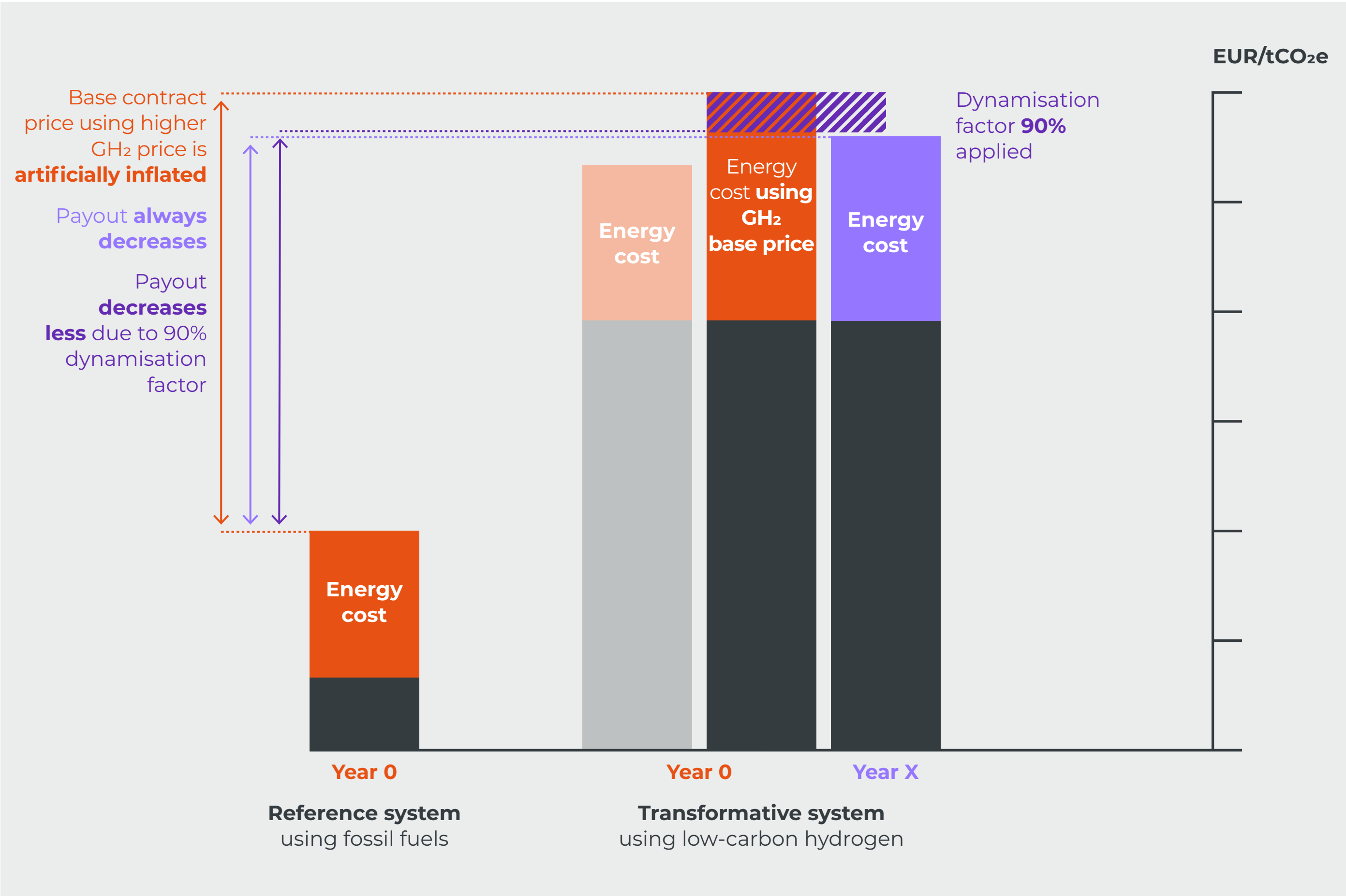
Together, these incentive structures and the dual criteria for bid evaluation seem to have favoured green hydrogen-based projects in the first funding round. However, the new public consultation draft of the KSV Funding Directive has proposed changes that will impact these dynamics in future funding rounds. On the one hand, it proposes to remove the relative GHG emissions reduction criterion and evaluate bids only on cost efficiency (BMWK, 2024d, para. 8.3(d)). This takes away the main competitive edge given to green hydrogen. On the other hand, it proposes to increase the price surcharge given to green hydrogen from 3% to 5% (BMWK, 2024d, para. 7.2(e)). This slightly increases the incentive for projects using green hydrogen to bid lower. It is unclear whether the positive impact of the increased surcharge on cost efficiency is enough to counteract the impact of green hydrogen losing the edge on the relative GHG emissions reduction criterion, even if the next funding round continues to apply the higher green hydrogen base price for "low-carbon" hydrogen.

If the incentives for green hydrogen fall short and a project using "low-carbon" hydrogen wins the auction, the presence of the dynamisation factor may lead to subsidy inefficiencies. The first funding call set the dynamisation factor for both "low-carbon" and green hydrogen at 90%. For green hydrogen, this works to protect both contracting parties from the full risk of energy price variability, as explained in **→ Section 1.1**. For "low-carbon" hydrogen, however, the artificially higher base price means there is no possibility of an increase in real energy price, such that there is never a risk of increased payout burden on the state. Thus, the presence of any dynamisation factor (other than 100%) always leads to a better payout for the company than in case it was absent **(→ Fig. 4)**, causing the KSV instrument to over-subsidise "low-carbon" hydrogen (Germanwatch, 2024).

The presence of such a dynamisation factor could even lead to a perverse incentive for projects to try and game the system to get more subsidy than needed. This would be possible as per the KSV Funding Directive, as projects are legally bound only to the quantities of hydrogen they plan to use over the years, not necessarily the type (BMWK, 2024c, para. 7.3). Thus, a project could announce its intention to procure green hydrogen at the time of bidding and later switch to "low-carbon" hydrogen (for example, claiming a shortage of supply or inadequate infrastructure) during the KSV contract. By doing so, a project could effectively obtain a higher payout in the years it uses "low-carbon" hydrogen than its true additional costs compared to the reference system due to the 90% dynamisation factor **(→ Fig. 4)**.

Fig. 4

Impact of setting the base price of "low-carbon" hydrogen equal to the price of green hydrogen on annual subsidy payouts, in the presence of a 90% dynamisation factor



2.4 HYDROGEN VALUE CHAIN INEFFICIENCIES ARE NOT FULLY ACCOUNTED FOR

The hydrogen value chain is associated with the risk of several inefficiencies. If hydrogen is produced far away, converted into derivatives for shipping, reconverted into hydrogen at the destination, and used in sectors that could have been directly electrified, this leads to high energy losses at every step and yields only a fraction of the original energy input at the point of utilisation (NewClimate Institute, 2023). In addition, hydrogen production is highly resource-intensive, requiring vast quantities of land and water per unit of production (NewClimate Institute, 2024). Thus, it is always more energy- and resource-efficient to directly provide the energy input at the point of utilisation (such as in the form of electricity) if technically possible.

The KSV Funding Directive explicitly tries to counter such potential inefficiencies. It states that the KSV only finances "transformative" projects, which by its own definition excludes processes that are not energy- and resource-efficient (BMWK, 2024c, para. 2.21). The granting authority is allowed to reject bids from projects that it does not consider transformative by seeking an assessment from a third-party expert (BMWK, 2024c, para. 8.3l).

The Funding Directive also includes some provisions to regulate how hydrogen production takes place, even though this falls outside funded project boundaries. It allows the granting authority to require projects producing large amounts of hydrogen (i.e., electrolyser capacity over 10 megawatts) to locate their hydrogen production plants close to industrial demand sites and contribute to electricity system flexibility (BMWK, 2024c, para. 4.9). This can minimise inefficiencies due to hydrogen transport and allow electrolysers to provide grid services that enable the integration of variable renewables.

Further, the Directive ensures that the hydrogen produced is used only for energy-intensive industrial applications. Projects that exclusively produce secondary energy carriers like hydrogen without consuming them in an industrial production process are not eligible for funding (BMWK, 2024c, para. 4.16(b)). Projects that produce hydrogen derivatives are funded, but only to the extent that these are not used for energy utilisation purposes, even if outside of the funded project (BMWK, 2024c, para. 4.5).

Upstream products are defined as preliminary products that are further processed into final industrial products that are funded by the KSV. The key difference between upstream products and intermediate products is that the latter are considered within funded project boundaries whereas the former are not explicitly funded.

These rules would not apply in the case of projects that do not produce hydrogen or derivatives but procure them from elsewhere (including through imports). However, the new public consultation draft of the KSV Funding Directive clarifies that emissions from upstream products used in projects, such as hydrogen used in the production of an industrial product, are accounted for when estimating its emissions reduction potential and associated costs (BMWK, 2024d, para. 7.1(d)). Thus, it is plausible that projects involving inefficient procurement or use of hydrogen or derivatives would translate the associated additional emissions and costs into higher bid prices, thus reducing their likelihood of winning a bid.

However, this mechanism might not be working perfectly. On the procurement side, the draft only mentions emissions from the manufacture and use of upstream products as being accounted, leaving ambiguity in terms of how emissions from long-distance transport of upstream hydrogen are treated (BMWK, 2024d, para. Annex 4). This would be the case when projects import hydrogen from countries far from Europe, which involves high risk of efficiency losses over the transport and storage part of the value chain. Explicitly accounting for emissions from the transport of hydrogen would align incentives for projects to prioritise hydrogen produced in and around Europe to the extent possible.

Similarly, the higher costs of using hydrogen instead of a more effective decarbonisation option where available might indeed be reflected in the bid price, but this does not guarantee that the bid is not awarded. If the costs facing other bidders are even higher, a project using hydrogen inefficiently may still win a KSV contract. This might explain how projects in manufacturing industries that do not typically have high industrial heat requirements, such as paper and packaging, adhesive tapes, and brickmaking, were able to win contracts in the first round of KSV funding (BMWK, 2024e). Although the specific details of these projects are not publicly available, electrification is generally a more efficient decarbonisation option in such industries than hydrogen. More regulatory incentives might be necessary to prevent such systemically inefficient outcomes. For example, the KSV Funding Directive requires projects using biomass to explicitly prove that they could not have relied on hydrogen or electrification. A similar requirement can be imposed on projects proposing to use hydrogen to ensure only the most efficient uses are eligible for funding. Further checks are also needed to ensure that such energy-inefficient uses of hydrogen do not qualify as "transformative" projects.

2.5 IMPORTED HYDROGEN FACES INADEQUATE SUSTAINABILITY REQUIREMENTS

The first funding call requires projects to obtain certifications proving that the hydrogen they use complies with the requirements given in the KSV Funding Directive (BMWK, 2024b, p. 6). As per the Funding Directive definitions, green and "low-carbon" hydrogen are required to deliver minimum lifecycle GHG emissions reductions of 70% and 73.4% compared to a fossil fuel alternative, respectively. In addition to meeting these emissions standards, projects using green hydrogen would have had to obtain certifications proving the additionality of renewable capacity, and those using "low-carbon" hydrogen would have had to prove compliance with environmental standards as per EU Delegated Regulation 2021/2139, as per their respective definitions given in the Directive **(see → Section 2.2)** (BMWK, 2024c, paras 2.6, 2.11).

The new public consultation draft, however, modifies the definition of "low-carbon" hydrogen to remove the obligation to comply with EU environmental objectives. This could be an inconsequential change, given that the cited EU regulation, in principle, applies to all types of hydrogen produced in the EU. Elsewhere in the Funding Directive, it is also stated that projects that significantly harm EU environmental objectives are not eligible for KSV funding (BMWK, 2024c, para. 4.16q). All this suggests that both green and "low-carbon" hydrogen produced in the EU are subject to high environmental standards, even if not explicitly defined as such in the KSV Funding Directive.

However, this introduces a potential loophole for projects that do not procure hydrogen produced in Germany or the EU but import it from outside. This hydrogen is outside the jurisdiction of EU environmental regulations. In the absence of explicit reference to these regulations in the definitions for green and "low-carbon" hydrogen provided in the KSV Funding Directive, these projects are not obliged to get certified for environmental sustainability the same way that projects using hydrogen produced within the EU would have to.

Further, the cited EU Regulation itself is limited, as it does not cover other aspects of social sustainability relevant to large-scale hydrogen projects. Important considerations include responsible siting of projects (i.e., avoiding social conflict due to competing uses of land or encroachment on cultural heritage sites), provisions for the safety of workers and communities located along the value chain, and mechanisms for stakeholder participation and grievance redressal during project preparation and execution (NewClimate Institute, 2024). It is entirely possible that these considerations are covered under other overarching EU regulations or German laws that are not cited in the KSV Funding Directive. However, they represent further omissions that imported hydrogen produced in other jurisdictions would not be explicitly obliged to comply with.

Finally, it is important for projects importing hydrogen to go beyond the do-no-harm principle on which EU regulations are based and actively add value to local communities. This is particularly relevant for hydrogen imported from Global South countries, where catering to huge export demands from Germany and the EU could slow down the domestic energy transition without necessarily offering proportionate industrial value addition opportunities. This development dimension of hydrogen is prioritised in Germany's hydrogen import strategy, which describes supporting local development, value creation, and decarbonisation as one of the objectives for Germany's support for establishing hydrogen markets abroad (BMWK, 2024f). This can be done, for example, by requiring projects to feed surplus electricity and water into local networks, contribute to domestic decarbonisation, create high-quality local jobs, and help develop domestic supply chains (NewClimate Institute, 2024). These objectives could be integrated into the KSV Funding Directive as additional project eligibility criteria.

The adoption of a holistic sustainability standard for hydrogen applied uniformly to imports is thus important for sustainable hydrogen governance. However, the current global landscape of standards and certifications reveals that most attempts at developing standards for hydrogen stop short of a holistic approach as defined above, instead focusing mainly on certifying hydrogen types based on their emissions intensities. To our knowledge, the only international standard currently available that takes a broader approach is the Green Hydrogen Standard, which accounts for the environmental and social impacts of green hydrogen development in addition to its emission intensity (GHO, 2022). No international standard accounts for local value creation impacts of hydrogen development.

/Λ 03 RECOMMENDATIONS

The KSV is a promising financial support scheme that offsets some of the high upfront costs and energy price risks of implementing an industrial decarbonisation project based on hydrogen. This provides stability and predictability to industrial players investing in the transition, thus enabling them to move towards future-proof technologies and increasing their long-term competitiveness.

As KSV contracts are awarded through competitive auctions, the scheme incentivises projects to maximise the cost efficiency of their GHG emissions reduction. However, we found gaps and loopholes in the policy documents underpinning the KSV scheme that may risk undermining the overall effectiveness and Paris-compatibility of the instrument. These gaps are particularly around support for "low-carbon" hydrogen, inefficiencies in hydrogen procurement and use, and sustainability standards for hydrogen imports. Based on our findings, we formulated the following key recommendations for BMWK:

→ **Exclude projects using "low-carbon" hydrogen from future funding rounds.** Both green and "low-carbon" hydrogen can be used by KSV-funded projects, but project boundaries are defined such that any hydrogen production lies outside the scope of funding. This is presumably done to comply with the NHS prohibition of direct public financing of "low-carbon" hydrogen production. However, projects that produce "low-carbon" hydrogen for industrial use can still include the associated costs in their bids, thus allowing subsidies to indirectly flow towards "low-carbon" hydrogen production. The revised draft of the KSV Funding Directive for public consultation removes the intention to eventually align funding with the NHS, thus allowing support for projects based on "low-carbon" hydrogen to continue indefinitely. To comply with the objectives of the Paris Agreement, the KSV should explicitly exclude any direct or indirect funding for fossil-based hydrogen, as this could strengthen demand for fossil fuels, lock in fossil-based industrial pathways, and lead to higher lifecycle emissions due to upstream fossil fuel production processes.

→ **Reinforce incentives provided to projects using green hydrogen to provide a clear competitive edge.** In case "low-carbon" hydrogen continues to be permitted in future auction rounds, it would be crucial to provide further incentives to projects using green hydrogen to demonstrate a clear preference. This could be done, for example, by keeping relative GHG emissions reductions as a criterion for bid evaluation, significantly increasing the dynamisation surcharge offered to green hydrogen (beyond the proposed 5% in the public consultation draft) and continuing to use a higher base price for "low-carbon" hydrogen in future funding rounds. Another option would be to substantially increase the price risk coverage offered to green hydrogen compared to "low-carbon" hydrogen by lowering the dynamisation factor for the former and applying a 100% dynamisation factor for the latter. Further, the emissions reduction threshold for "low-carbon" hydrogen should be kept higher than that for green hydrogen to signal a clear preference for the latter. Robust accounting guidelines should be enforced to ensure upstream emissions from "low-carbon" hydrogen production are fully counted and that "low-carbon" hydrogen does not easily meet the minimum emissions reduction threshold.

→ **Ensure explicit accounting of transport emissions of upstream hydrogen so that the bidding process leads to the most efficient outcome.** For upstream products used in a funded project, such as hydrogen or its derivatives used to make an industrial product, the public consultation draft only explicitly provides for the accounting of emissions involved in their manufacture and use. This could imply that emissions arising from the transport of hydrogen are omitted, which can be a significant share of the lifecycle emissions of imported hydrogen. Explicitly accounting for these emissions would align incentives for projects to prioritise hydrogen and derivatives produced close to the project location to the extent possible.

→ **Implement regulatory safeguards to prevent inefficient utilisation of hydrogen.** The KSV design incentivises companies to minimise additional costs of implementing decarbonisation projects. It follows that the cases where hydrogen is not the most efficient decarbonisation option would automatically be less competitive in an auction. However, such projects might still win contracts depending on their relative costs compared to competitors in the auction. Further regulations are thus required to exclude projects proposing inefficient utilisation of hydrogen, for instance, in industrial sectors that could be electrified. The KSV Funding Directive should require projects using hydrogen to demonstrate that electrification was not technically viable, as it does for projects using biomass. It should also put in place robust checks for evaluating a "transformative" project bid, such that a proposal for inefficient use of hydrogen would not be eligible for funding in the first place.

→ **Adopt a holistic sustainability standard for hydrogen used in funded projects and apply it to imports as well.** It is necessary to have holistic and uniformly applicable standards promoting environmentally and socially responsible hydrogen. Germany should lead the way in developing such a standard that ensures compliance with high social and environmental safeguards as well as contribution to local economic development and decarbonisation pathways of hydrogen exporting countries. Currently, KSV-funded projects using hydrogen produced in Europe are automatically subject to EU environmental and social regulations, but hydrogen imported from elsewhere would not be obliged to comply, especially under the revisions made in the public consultation draft of the KSV Funding Directive. The KSV Funding Directive should explicitly require all types of hydrogen, regardless of where it is produced, to comply with a holistic sustainability standard.

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ANNEX: ASSESSMENT CRITERIA

Tab. 1

Checklist of key considerations and rationale for inclusion in the assessment of the KSV instrument

Category	#	Consideration	Standard	#	Questionnaire
Paris-alignment	**1**	Exclusively support green hydrogen	Green hydrogen is the only form of hydrogen produced and combusted with zero emissions	**1.1**	Is it explicitly stated that the instrument will exclusively support green hydrogen projects?
				1.2	Is the instrument designed to favour green hydrogen and/or avoid favouring other types of hydrogen?
	2	Prioritise application in no-regret sectors	Hydrogen should be reserved for hard to abate applications which cannot be electrified	**2.1**	Does the instrument explicitly rule out the use of hydrogen for end uses that can be electrified?
				2.2	Is the instrument designed to favour no-regret projects (i.e., using hydrogen in hard-to-abate sectors or long-term/seasonal energy storage for grid flexibility)?
	3	Promote production close to demand centres	Long-distance transport of hydrogen leads to significant energy losses	**3.1**	Are projects producing hydrogen explicitly required to be located close to planned demand centres?
				3.2	Is the instrument designed to reflect long-distance transport costs and efficiency losses?
	4	Ensure sustainable sourcing of carbon for downstream products	Carbon sourced unsustainably can lock-in demand and emissions	**4.1**	Are projects required to use only sustainable carbon sources to make downstream products?
				4.2	Are projects required to ensure that carbon capture processes (DAC or CCU) only use electricity and heat from additional renewable energy sources?
				4.3	Are projects required to ensure that carbon is sourced from unavoidable industrial process emissions (e.g., cement)?
				4.4	Are projects required to ensure that carbon is sourced from sustainable biogenic sources?
Local economic benefits	**5**	Ensure industrial value capture	Hydrogen development should support local economic development and value capture	**5.1**	Are supported projects encouraged to source industrial equipment domestically?
				5.2	Does the instrument encourage production of higher value added derivatives or downstream products of hydrogen?
	6	Promote local jobs and skills development	Hydrogen development should support high-quality and long-term employment and skill development	**6.1**	Does the instrument prioritise employment of domestic workforce in supported projects?
				6.2	Does the instrument require project developers to invest in local skills development and knowledge transfer?
	7	Contribute to domestic decarbonisation	Hydrogen should contribute to decarbonisation of domestic industries in addition to exports	**7.1**	Are supported projects required to prioritise application of green hydrogen for domestic decarbonisation?

Category	#	Consideration	Standard	#	Questionnaire
Sharing access to local resources	**8**	Improve access to renewable electricity	Hydrogen development should contribute to improved resource access in areas with scarcity	**8.1**	Are supported projects required to build additional renewable power capacity and share surplus electricity with the power grid or local network?
				8.2	Are supported projects that do not build additional renewable power capacity required to run electrolysers exclusively in surplus renewable generation hours?
	9	Safeguard local access to land resources	Land use for project siting should be based on social justice	**9.1**	Are supported projects required to ensure sustainable land use (consider competing uses, avoid encroachment, establish arrangements for sharing access, fair compensation for restricting use of local communities)?
	10	Safeguard local access to water resources	Water use for production should not increase scarcity or lead to pollution	**10.1**	Are supported projects required to ensure sustainable water use (e.g., prioritising recycled water, avoiding groundwater use, locating away from high water stress regions)?
				10.2	Are supported projects required to build additional water treatment capacity (e.g., desalination, wastewater recycling) and share surplus freshwater with the local distribution network?
				10.3	Are supported projects required to establish arrangements for sharing access to ocean resources (or the revenues generated from restricting use) with local communities?
Environmental and social safeguards	**11**	Protect nature and biodiversity	Project siting should not harm to biodiversity and natural ecosystems	**11.1**	Are supported projects required to avoid areas of high biodiversity value?
				11.2	Are supported projects required to comply with high standards for effluent treatment and pollution control?
	12	Protect workers and communities	Hydrogen value chains should not endanger workers or communities	**12.1**	Are supported projects required to locate away from residential or community hubs?
				12.2	Are supported projects required to comply with high standards for worker safety?
	13	Protect cultural heritage sites	Hydrogen value chains should not infringe upon cultural heritage sites	**13.1**	Are supported projects required to avoid areas of high cultural heritage value?
Governance	**14**	Ensure stakeholder participation	Project development must be based on stakeholder participation with free, prior, and informed consent	**14.1**	Are supported projects required to establish mechanisms for stakeholder consultations under free, prior, informed consent (FPIC) before and during project implementation?
				14.2	Are supported projects required to establish mechanisms for grievance redressal during project implementation?

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