REPORT

Industrial power prices

Design options for a temporary production subsidy for internationally competing industries with high electricity cost-intensive industry in international competition

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Neon Neue Energieökonomik is an energy industry consultancy based in Berlin. As a boutique, we have specialized in sophisticated quantitative and economic-theoretical analyses of the electricity market since 2014. With consulting projects, studies and training courses, we support decision-makers with the current challenges and future issues of the energy transition. Our clients include governments, regulatory authorities, grid operators, energy suppliers and electricity traders from Germany and Europe.

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1 Objective

Primary objective. The industrial electricity price is intended to support industrial companies in the short to medium term whose production and continued existence in Germany is in question due to the sharp rise in electricity prices since 2022. In our view, the primary aim of this subsidy is to buy time: Time that is needed to make an informed decision on which industrial companies should remain in Germany in the long term for geopolitical and strategic reasons despite high energy prices.

Secondary conditions. In addition to the overarching goal of "buying time", the production subsidy also pursues other goals. The selection of these additional objectives largely determines how the instrument should be designed. We distinguish between two groups of objectives: those relating to the electricity market and industrial policy objectives.

Electricity market objectives. A secondary objective of the instrument is to create incentives to make electricity consumption more flexible. This includes incentives to shift load from hours with high electricity prices to hours with low electricity prices as well as incentives to save electricity when there is a shortage, for example in the event of a dark doldrums. Another electricity market objective is to maintain the incentives for efficient electricity procurement by companies. To achieve this, it is necessary that it remains attractive to purchase electricity cheaply and at an early stage and to actively manage one's own balancing group.

Industrial targets. In addition to the targets for the electricity market, a variety of industrial targets are possible. One conceivable objective of a production subsidy would be to expand or maintain production levels as well as to reduce production, as was the case in the acute gas crisis. In our view, however, the aim is not to reduce production in Germany. In addition, the production subsidy could also be aimed at promoting energy efficiency or the electrification of consumption. In our view, neither of these is the case, as there are other, more suitable instruments for this.

Other objectives. Occasionally, the objective is also formulated in the discussion that the industrial electricity price should focus in particular on long-term price stability and offer an insurance function against electricity price fluctuations. A completely different set of instruments would be recommended for this (for example, the assumption of default risks in PPAs), which we will not discuss further below.

Structure. In this brief study, we present existing industrial subsidies and explain how an industrial electricity price can be combined with the removal of barriers to flexibility. We then provide recommendations for designing the industrial electricity price in line with the electricity market. We have not investigated whether it makes economic sense to introduce such a subsidy, what sectoral definition it should have, how high it should be and how it can be financed.

2 Existing industry subsidies

Existing subsidies. The introduction of a production subsidy for electricity cost-intensive industries would supplement a large number of existing subsidies. In particular, electricity price compensation and the special equalization scheme (BesAR) are two instruments that also support electricity cost-intensive industries in international competition in order to prevent the relocation of production abroad. While electricity price compensation is a direct payment to industrial companies, other instruments reduce or exempt companies from levies, taxes or surcharges. For example, the BesAR means that beneficiary companies only pay a fraction of the levies to finance CHP plants and offshore connections (including the EEG levy until mid-2022). The electricity tax and the reduction in grid charges for certain consumers in accordance with Section 19 of the Electricity Grid Charges Ordinance are similar.

Scale and most important sectors. Figure 1 shows an estimate of the various subsidies in 2021, expressed in monetary terms per megawatt hour of electricity consumption. On average, we estimate that industry benefited from subsidies of around €33/MWh, with significant differences between sectors. In extreme cases, subsidies of over €100/MWh are possible. However, the distribution of subsidies has changed significantly since 2021. In particular, the abolition of the EEG surcharge in 2022 means that the BesAR has fallen from just under €6 billion a year to around €1 billion in 2023. In contrast, electricity price compensation rose from €0.8 billion to around €3 billion. In addition, transmission grid fees have been reduced by almost €13 billion since 2023 due to subsidies from the Economic Stabilization Fund.

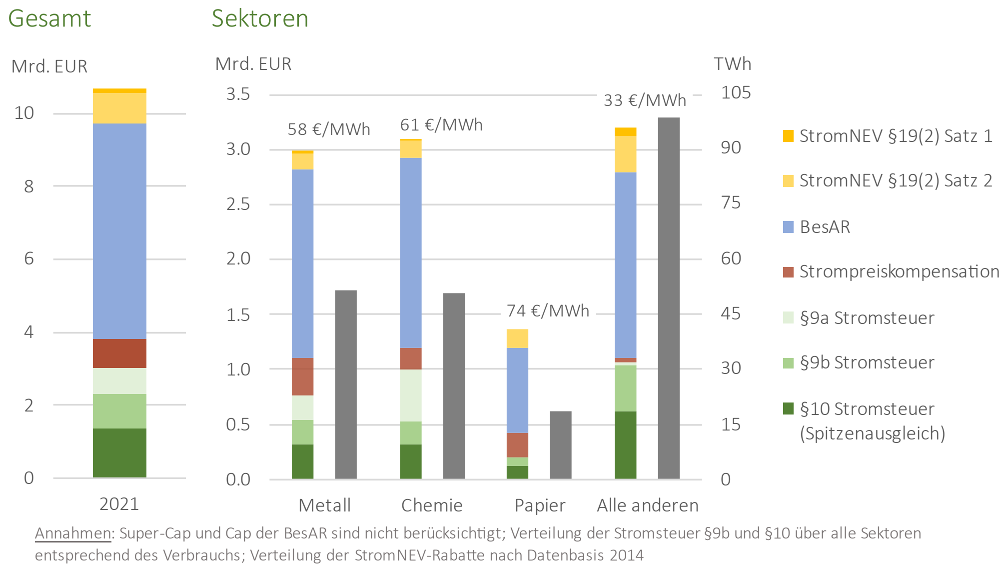

Figure 1 : Industrial subsidies in 2021 and breakdown by the most important sectors

3 Promoting industry by removing barriers to flexibility

Flexibility of industrial demand. The share of variable renewable energies such as wind and solar energy in the German and European electricity market will continue to increase. As a result, fluctuations in the electricity price are also likely to increase further. In hours when there is an oversupply of wind and solar energy, electricity will be very cheap, whereas on cold winter evenings without wind, it could become significantly more expensive than before. The prerequisite for a competitive energy-intensive industry in Germany is therefore likely to be that it can also adapt to short-term fluctuations in electricity prices and benefit from low prices in a targeted manner. The aim of industrial policy in Germany must therefore be to remove regulatory barriers that prevent demand in Germany from becoming more flexible. Flexibility incentives should therefore be a guiding principle in the design of an industrial electricity price.

Barriers to flexibility through grid charges. In Germany, there are a number of regulatory framework conditions that stand in the way of making industrial consumption more flexible. Grid charges in particular provide strong incentives against the flexibilization of consumption, as industrial consumers pay significantly lower grid charges for consistent electricity consumption. Consumption uniformity is measured in annual hours of use, the quotient of peak load and annual consumption. The lower the peak load of a consumer (with constant consumption), the greater the number of annual hours of use and the lower the average grid charges.

Example. Figure 2 shows this using the example of the Berlin medium voltage. With a flexible system design with variable electricity consumption and consequently low full utilization hours (left), the grid charges are structurally higher than with a design for inflexible base load operation (right). For example, a system with 100 hours of use per MWh pays 32 times higher grid charges than a system in continuous operation.

Mechanisms of action. There are three primary mechanisms for incentivizing consistent electricity consumption:

- Differently high labor and power prices below and above 2500 annual usage hours
- High discounts for consumers with over 7000 hours of use
- Power price that massively penalizes peak loads

Tariff structure. The level of the output and energy prices differs depending on whether a consumer has more or less than 2500 annual usage hours. Above this threshold, the energy price is significantly lower than below. The demand price increases, but as its costs are spread over a much higher consumption, the average grid charges fall as the annual usage hours increase.

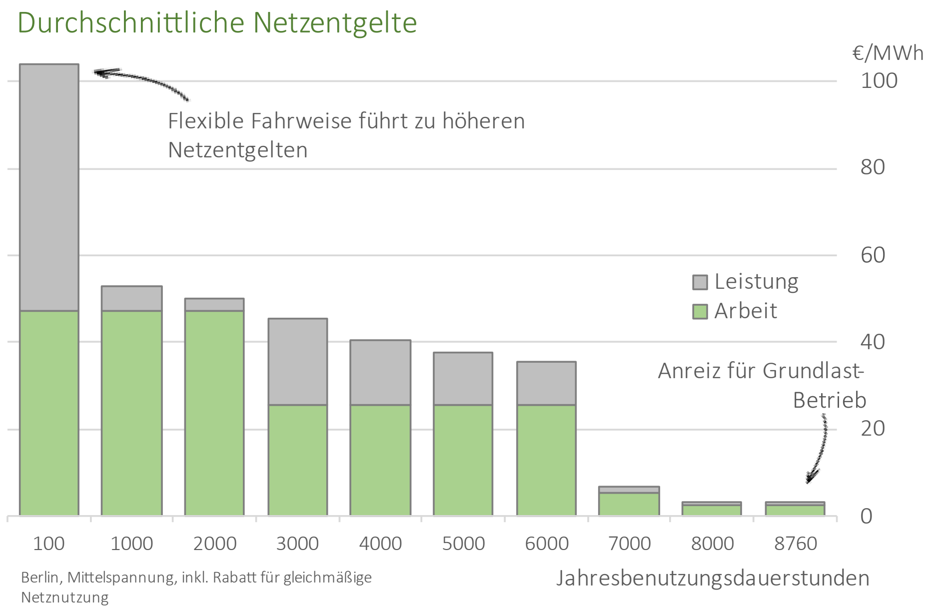

Figure 2 . Grid charges for different full usage hours for large customers in Berlin connected to the medium-voltage grid (incl. discount for even grid usage)

Discounts. These incentives for consistent electricity consumption are massively reinforced by the discounts for consistent grid usage (Section 19 sentence 2, paragraph 2 of the Electricity Grid Charges Ordinance). This stipulates that the grid fees can be reduced by up to 80% or 90% for over 7,000 annual hours of use. These exemptions mainly benefit very large electricity consumers, particularly in the paper, chemical and aluminum industries. In 2022, the benefiting companies collectively saved grid fees of around EUR 1 billion for a consumption of 90 TWh, which corresponds to an average saving of 1.1 ct/kWh. However, due to the different levels of grid fees depending on the consumption profile, voltage level and distribution grid operator, the distribution of discounts is very heterogeneous and the savings of individual consumers are significantly higher.

Power price. The demand charge is one of the reasons for the higher average grid fees for consumers with few annual usage hours, because the same costs then have to be allocated to a lower energy consumption. However, an examination of the effect of the demand charge for additional (marginal) electricity consumption reveals another problem with the demand charge. In fact, the grid fees that consumers pay for an additional ("marginal") MWh vary greatly throughout the year: If electricity is purchased below the peak load, only the energy price is due. If the current electricity consumption is already at peak load, an increase in consumption leads to a higher power payment. In other words: in these hours, the grid charges due for an increase in consumption are much higher.

Example of power price. The example of an industrial company in Berlin with a connection to medium voltage shows that this practically excludes the provision of flexibility in the form of short-term increases in consumption. If a consumer consumes an additional 1 MWh in just a single quarter of an hour, the capacity price must be paid for an additional 4 MW, which is almost EUR 240,000 in Berlin's medium-voltage grid. The effective grid fee for this additionally consumed energy is therefore just under € 240,000/MWh - almost ten thousand times more than the working price of around € 26/MWh. Even if the additional MWh consumed is spread over 100 hours, it still amounts to €600/MWh, i.e. 20 times more than the energy price. This example shows that it is practically never worthwhile for load metered customers to increase their electricity consumption beyond the peak output, e.g. in order to consume local surplus electricity (for which there is currently no economic incentive anyway), simply because of the existence of grid fee power prices. The uncertainty of future price developments also makes it difficult to predict which load peaks will still be worthwhile over the course of the calendar year. This reinforces the reluctance of flexible consumers to exploit their flexibility potential.

Wrong incentives. In many companies, it is therefore a key task of energy management to optimize electricity consumption in terms of uniformity. Existing flexibility potential is therefore used to achieve the most even electricity consumption possible. This prevents industrial companies from benefiting from fluctuating electricity prices by consuming more at times of low or even negative exchange prices, thereby contributing to the better integration of renewable energy.

Proposal. We therefore propose using the introduction of the explicit production subsidy to remove existing barriers to flexibility. To this end, we propose a grid fee reform along the following lines:

- Cancellation of discounts for equal grid usage (StromNEV §19.2 sentence 2) and flat-rate compensation for the companies affected
- Further development of discounts for atypical grid usage (StromNEV §19.2 sentence 1) into time-variable grid charges
- Reform of power prices so that they at least approximately reflect the actual contribution to the grid load and are no longer based on the individual load.

Equal grid usage. As a first step, we recommend deleting the exemption rule for discounts for even grid usage. The discounts are a significant barrier to the flexibilization of consumption. They stipulate that consumers with over 7,000 annual usage hours receive a reduction of up to 80% on the grid fees (discounts of up to 90% are even possible for higher usage hours). The problematic incentives of the rebates therefore do not arise from the rebates themselves, but from the condition that entitles the consumer to receive the rebates.[1] They encourage the use of existing flexibility potential, e.g. through large batteries or load management, to stabilize grid consumption. This makes the integration of renewable energies more difficult. This considerable incentive to stabilize consumption also prevents short-term load peaks, even if these would relieve the grid. In order to keep the additional burden on industrial consumers within reasonable limits, we propose compensation for energy-intensive companies that are in international competition. This takes the form of a lump sum for grid costs through the production subsidy (see section 4.1.2)

[1] Decision BK4-22-089 of the Federal Network Agency dated 15.02.2023 shows that the competent ruling chamber also sees these problematic incentives.

Atypical grid usage. Discounts for atypical grid usage are granted to consumers whose peak load deviates predictably and significantly from the annual maximum load at the same grid or transformer level. For this purpose, so-called peak load time windows are defined at the beginning of the year, during which the maximum load of the consumers may not occur. We recommend further developing this fundamentally sensible regulation in the direction of dynamic grid charges in the medium term. To this end, we initially recommend that the reduction in charges only be granted for consumption outside the peak load time windows and no longer for consumption that also occurs within the peak load time windows. It is also conceivable to allow dynamic suspensions of the static peak load windows announced by the DSO at short notice when high local generation occurs. This enables the use of local surplus electricity instead of curtailment.

Reform of demand charges. Finally, we recommend a reform of the demand charge so that it at least approximately reflects the actual contribution of each consumer to the grid load. The demand charge currently only takes into account the individual maximum load, regardless of whether this contributes to the peak load of the grid. This means that it also penalizes peak loads, even if these relieve the local grid, for example if they compensate for generation-related peaks.

4 Recommendations for the design of the subsidy

Focus. The analysis focuses on compensation for the increased electricity costs of selected industrial companies. The target group are companies that produce in Germany and are in international competition. The subsidy is a reaction to the short and medium-term increase in electricity costs as a result of Russia's attack on Ukraine. One requirement is therefore that the subsidy amount is dependent on the general electricity price level in Germany.

Fixed price. The previous debate about a production subsidy was held under the catchphrase "industrial electricity price". This term suggests a pre-defined electricity procurement price for industrial companies that remains constant over time. In a simple version, industrial companies would be reimbursed the difference between their actual, verifiable electricity bill and this target price. However, this variant is highly problematic. On the one hand, it would mean that the industrial companies concerned would no longer be exposed to any incentives to flexibilize, as their costs would be decoupled from the price signals of the wholesale market. As the cost difference is offset anyway, it is irrelevant for the companies whether they consume electricity in hours with low or high wholesale prices. As a result, all incentives to shift energy-intensive processes to hours with high RE generation ("load shifting") or to reduce consumption in the event of a dark doldrums ("situational energy saving") would be lost. Incentives to procure electricity efficiently would also be lost. As excessive costs are reimbursed anyway, an expensive electricity contract is just as good as a cheap one (with the similarly designed electricity price brake, customers could even benefit from more expensive tariffs). If, as would be consistent, the sometimes very high costs for balancing energy were also covered, the incentives to manage one's own balancing group would even be removed. In addition to very high costs, this would also jeopardize system security.

reference price. Instead, we recommend basing the payment on a reference price, which is a benchmark for the current electricity price. The subsidy would therefore be calculated as the difference between the reference price and the target price:

$$\underset{(€)}{\text{Subvention}} = \left(\underset{(€/MWh)}{\text{Referenzpreis}} - \underset{(€/MWh)}{\text{Zielpreis}} \right) \times \underset{(MWh)}{\text{Menge}}$$

This design preserves the incentives for flexibilization of demand, efficient electricity procurement and balancing group management. In the following three sections, we present how the reference price, target price and remunerated quantity should be sensibly determined and the resulting incentives for the industrial companies concerned.

4.1.1 Reference price

exchange price. As already mentioned, Neon recommends that the payment is *not* based on the individual electricity price actually paid, but on a reference price (benchmark). For example, the average spot price of a year can be used for this purpose. This approach preserves the incentives to make consumption more flexible: Companies benefit if they shift consumption from hours with high prices to hours with lower prices because they reduce energy costs but at the same time the subsidy level remains unaffected. The incentives for efficient procurement also remain in place because subsidized companies continue to benefit from low procurement costs.

Preliminary consideration. How the reference price is determined has an influence on the risk-minimizing procurement strategy of the subsidized companies. This is because if they purchase their electricity at the reference price, they are protected against price fluctuations by the subsidy. Consumers with a constant load profile would have perfect price hedging through the combination of procurement at the procurement price and the subsidy.

Forward vs. spot price. For this reason, we recommend not using the spot price as the reference price, but a forward price that is known in advance. For example, the reference price for 2024 could be determined from the average of the daily settlement prices of the base product for 2024 (see Figure 3). Using the average forward price as the reference price creates an incentive for subsidized consumers to procure the expected electricity consumption on the forward market. This is desirable in principle, as it stimulates the futures market on the consumer side. This counteracts the fact that producers tend to want more long-term hedging than consumers. If the reference price were to be calculated as the average spot price for a year, the incentive for subsidized consumers to procure their electricity requirements early on futures exchanges would disappear because the state would effectively take over the hedging function. This would significantly reduce the liquidity of the futures markets.

Figure 3 : Calculation of the reference price based on the settlement prices on the futures market

PPAs. The choice of the exchange-based futures market as a price reference for determining the subsidy amount does not force companies to procure on the futures market. They can continue to procure electricity on the spot market or via long-term PPAs, for example. However, they then bear the risk of a falling futures market price, so that the intervention tends to make PPAs less attractive from a risk perspective. In our opinion, this cannot be avoided and is one of the reasons why the subsidy should be limited in duration.

Design. For the reasons outlined above, there is a conflict of objectives with regard to the length of the period in which the forward prices are included in the calculation of the reference price. Consumers only have the opportunity to align their procurement strategy with the reference price if the time of price determination is not in the past and trading at the corresponding price is therefore possible at all. This cannot be completely prevented if such a subsidy is introduced in the short term. However, we recommend extending the period under consideration for the duration of the instrument. This would then create incentives to become active on the futures markets several years in advance.

Further advantages. Linking the subsidy level to a reference price based on forward prices has further advantages in addition to the arguments listed above. Firstly, the costs of the instrument are easier to plan. The amount of the price difference between the forward price and the target price is already fixed at the beginning of each year. Even if, for example, spot prices on the electricity market rise sharply due to a tightening of the gas supply, the subsidy does not have to be increased. This simplifies planning for both companies and the federal budget. Secondly, it is possible in the future to calculate the reference price on the basis of average forward prices on international electricity markets. This would mean that the level of subsidy would fluctuate. On the other hand, consumers have the certainty that they will not pay higher prices on average than in other alternative economic locations. Thirdly, any future bidding zone sharing would not have any distributional effects on consumers who receive the production subsidy, as this would protect consumers against rising costs in a smaller bidding zone. This would make bidding zone splitting politically easier.

4.1.2 Target price

SPK. The target price indicates the level to which the electricity costs should be reduced by the subsidy under discussion. When defining the target price, we recommend taking electricity price compensation into account. The new production subsidy would then be reduced by the existing electricity price compensation in order to avoid double relief.

Grid charge compensation. Grid fees should also be taken into account when determining the target price. In Germany, but also in other regions of the world, these can make up a significant proportion of electricity costs, but are rather low for large industrial consumers. However, there are significant differences in the level of grid charges depending on the voltage level, distribution grid operator and consumption profile. These differences should not be taken into account individually, particularly in order to avoid removing incentives from future time-variable grid charges. Instead, we propose a flat-rate consideration of the grid charges. This variant would have the advantage that it would make it possible to abolish the discounts from Section 19 sentence 2 of the Electricity Grid Charges Ordinance, as most of the companies affected would be compensated by the production subsidy. As a rough estimate, the grid fees for large industrial consumers are in the region of 1-2 ct/kWh without taking into account the discounts under Section 19 StromNEV. This estimate applies to large consumers with a high-voltage connection, 7,000 annual usage hours and 155 GWh annual consumption. At the current futures market exchange price of around 15 ct/kWh, this results in a subsidy of 6.5 ct/kWh for a target price of 6 ct/kWh, for example.

Figure 4 shows what a calculation could look like, taking into account electricity price compensation and flat-rate compensation for grid fees.

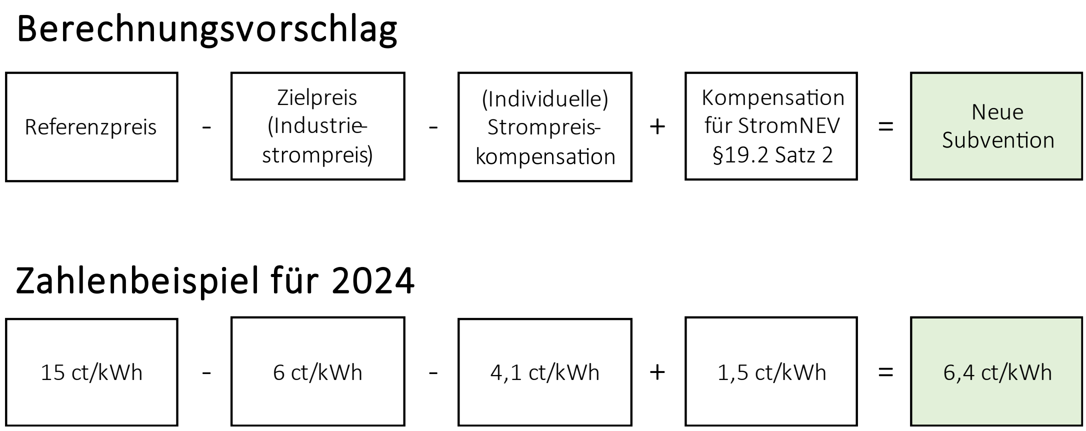

Figure 4 : Proposed calculation of the production subsidy and influencing variables taken into account

4.1.3 Quantity

In addition to the definition of the price and its payment, another key design feature is the consumption volume for which this price is paid. The decision as to which consumption volume is taken into account depends to a large extent on whether the financial survival of companies is to be ensured or their production boosted. It also influences the incentives to which the consumers concerned are exposed.

Energy crisis. In the energy crisis following Russia's attack on Ukraine, the primary goal was to save energy by reducing consumption. Consumption was to be subsidized, but consumption reductions were still to be worthwhile. This was achieved through infra-marginal subsidization: by taking into account only 80% of the previous year's electricity consumption, incentives to save remained in place and the incentives from the electricity market were not affected.

Realized electricity consumption. Reducing consumption by cutting back on production is no longer a goal. Instead, production in Germany should be maintained. It therefore makes sense to use actual consumption as the basis for assessment. This means that companies would be paid the difference between the reference and target price for every MWh of electricity consumed. This type of subsidy also creates incentives to switch from fossil fuels to electricity, as this increases the subsidy amount. The incentives to reduce electricity consumption, on the other hand, are minimal, as this would reduce the amount of subsidy.

Promotion of manufactured products. An alternative would be to make the subsidy dependent not on electricity consumption (input) but on the goods produced with it (output). This would have the advantage that energy efficiency incentives would remain fully intact. Benchmarks can be used to convert the production volume into an equivalent amount of electricity. The benchmarks are based on how much electricity an efficient process would require to manufacture the product. For example, the benchmark market for the production of aluminum is 13.9 MWh per ton. The manufacturer would therefore receive 13.9 times the difference between the reference price and the target price (in euros per MWh) per tonne of aluminum produced, regardless of how much electricity was actually used for production. This design variant creates stronger incentives to improve energy efficiency: a reduction in electricity consumption with the same output would not lead to a reduction in the subsidy volume. Such a procedure is already established through electricity price compensation, in which corresponding product benchmarks are also defined. For processes for which no benchmarks have (yet) been defined, the realized electricity consumption could also be used as a fallback option.

Figure 5 summarizes the discussion of the three design variants.

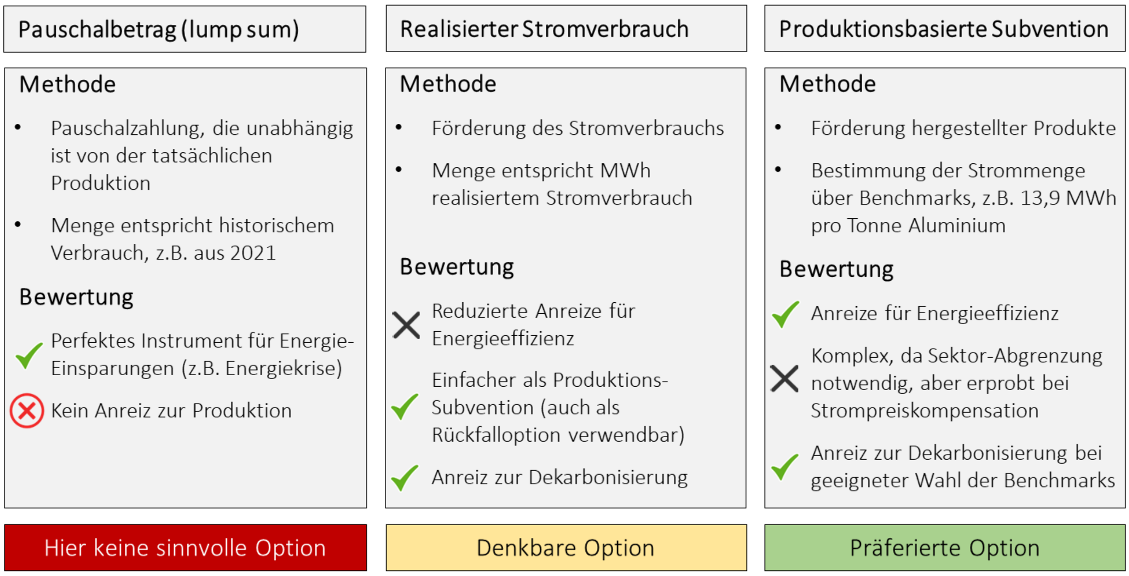

Figure 5 : Overview of conceivable methods for determining the quantity basis of the production subsidy