



The power envelope via iMSys as a standardised instrument for managing flexibility



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Abstract

The increasing integration of decentralised generation plants, electromobility and heat pumps poses growing challenges for low-voltage grids with regard to grid stability and at the same time opens up considerable economic potential. In order to exploit these potentials and effectively address network bottlenecks, a system-friendly, intelligent control of generation and consumption facilities is required.

This impulse paper shows how the iMSys infrastructure under construction can be further developed from a primarily curative to a preventive and market-embedded design. For this purpose, the concept of a power envelope is presented as a central control instrument. In addition to the technical and procedural basics, possible applications for different market players are shown.

The paper is based on conceptual, technical, procedural and scientific work as well as practical implementations in the WARAN project consortium. Results were coordinated and harmonised with the SiSSy project consortium. The participating companies represent the relevant market roles as well as hardware and system manufacturers. The impulse paper sees itself as a contribution to the technical discussion.

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Using flexibility in low-voltage networks

The advancing energy transition is characterised, among other things, by the increased expansion of volatile decentralised generation plants and higher power consumption in low-voltage networks, for example by heat pumps and electromobility. Around 57 GW of rooftop photovoltaic (PV) systems are already installed today. By 2045, this figure could rise to 400 GW (BNetzA I, 2025). For heat pumps, home storage systems and electric vehicles, the installed capacity could grow from around 50 GW by 2045 to just under 600 GW (the peak load in Germany today is around 80 GW) (BNetzA I, 2025). This development opens up considerable potential for providing flexibility. For owners of DER, the potential means the ability to reduce electricity costs and generate additional revenues; For suppliers and aggregators, new business models are emerging. A study carried out by Roland Berger estimates the total economic benefits of decentralised energy solutions in Germany to an added value of up to 255 billion euros in the next 20 years (Sauthoff & Löber, 2025).¹

However, this development poses new challenges for power grids. Electric cars and heat pumps demand electricity with higher performance and simultaneity than usual household appliances. This is in addition to the already heavy load caused by the volatile feed-in of the PV systems. The result is an increased need for network expansion. According to the current network expansion plans, distribution grid operators expect investment costs of 227 billion Euro until 2045 (FfE I, 2025). It is often not yet taken into account that this can be even higher if the flexibility of electric vehicles, heat pumps and home storage systems is optimised in a market-oriented manner (based on price signals), and thus with high simultaneity. Grid operators therefore need tools to safely and efficiently integrate the new consumers and the supply of PV systems into their networks.

On the consumption side, the Federal Network Agency (BNetzA) created the possibility of grid-oriented control of flexible consumption systems as an emergency measure by the network operators at the low voltage level in November 2023 with the provision of § 14a EnWG. In addition, the time-variable grid charges introduced for the first time an incentive-based and voluntary instrument for network-oriented flexibility provision. Whether this can achieve the desired grid relief at the low voltage level is questionable (FfE II, 2025). In some circumstances, even negative network effects can be expected. On the feed-in side, the legislator has also reacted and defined the control from a plant size of 2 kW with the adaptation of § 9 EEG. In order to ensure reliable control, § 12 of the EnWG also introduces the obligation to carry out an annual test of network-related

¹In the following, decentralised generation plants, controllable consumption devices such as heat pumps, electric vehicles and home storage as well as energy management systems are collectively referred to as controllable plants.

control. Newly installed plants for which the proof has not been provided are only allowed to feed into the power grid with 60% of their maximum power.

The discussion about network-oriented integration is far from over. In industry and science, a large number of different mechanisms have been discussed for several years (FfE III, 2025). The cyber-secure and standardised control systems available for the implementation of § 14a EnWG now offer the possibility to actually implement further mechanisms in practice. This includes the so-called power envelope. Such an envelope can be used both for implementing grid integration measures and for market-oriented control of flexibility by marketers. Figure 1 shows this interplay conceptually.

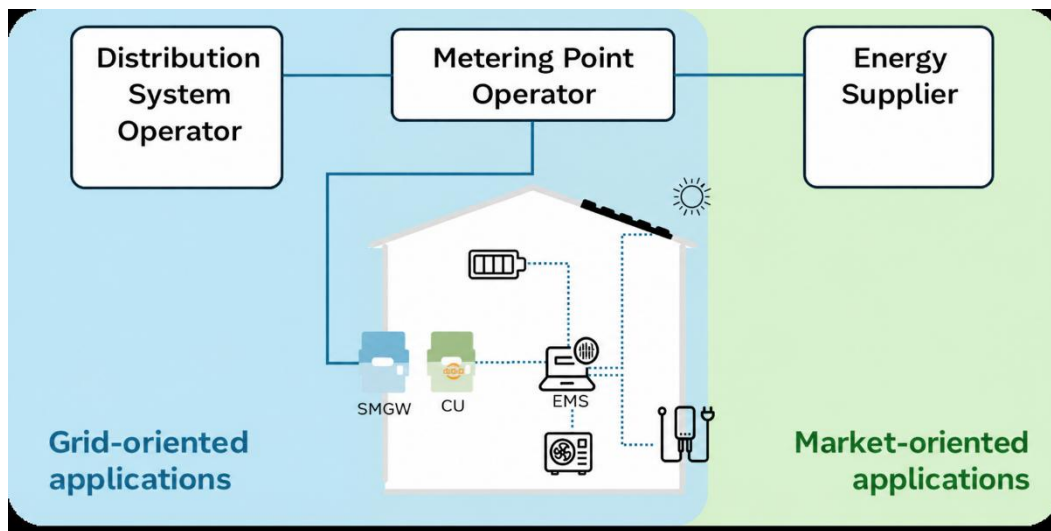


Figure 1 of grid and market-oriented governance

The present paper shows that

- how the standardised control can be extended via Smart Meter Gateway and control unit for implementing the power envelope;
- which use cases for network operators and marketers can be implemented by the envelope;
- the role of the metering point operator (MPO) in this process;
- how the transmission of the envelope can proceed procedurally using examples.

Parallel to the work in the research project WARAN, a project group at the VDE FNN has dealt with the opportunities of envelope control. At the beginning of February, the paper “Concept description for forecast-based control between network and market via iMSys and Flexband” was published (FNN I, 2026). The present paper can be understood as supporting and supplementing the embodiments of the FNN pulse.

What is a power envelope?

A power envelope (short power envelope) is a time-dependent specification for the maximum and/or minimum energy consumption, i.e. delivery of one or more controllable installations. The power envelope thus specifies a power range in which the controllable installations may move. The power envelope is implemented by an energy management system (EMS), which orchestrates the controllable systems of a property. The EEBUS Use Case Power Envelope (POEN) represents an envelope specification and will be considered in more detail below. EEBUS was selected as the protocol, as control via the intelligent metering system (iMSys) is considered and EEBUS was set by the BNetzA in conjunction with the FNN as the minimum digital standard for network-related control via the iMSys (BNetzA II, 2025). Via the VDE-AR-E 2829-6-1, the POEN application is already part of standardization and is known in the industry. This is also taken up in the implementation note “steering with verification in the SMGW” of the BSI. It can therefore be assumed that protocol extensions are possible for manufacturers of control devices and systems or EMS via software updates. The control is based on the same logic as a § 14a command. This logic is explained in more detail in the following infobox.

The POEN is shown schematically in Figure 2. The power Figure 2 for both energy directions. A distinction is made between an outer and an inner power envelope. The outer power envelope sets the guardrail for the maximum consumption or the maximum feed of the controllable installations. The inner power envelope stimulates consumption or feeding-in and does not necessarily have to be set. A valid envelope can be transferred for the next 48 hours at most and adjusted as often as desired. The limits are given in power, i.e. W.

Envelope

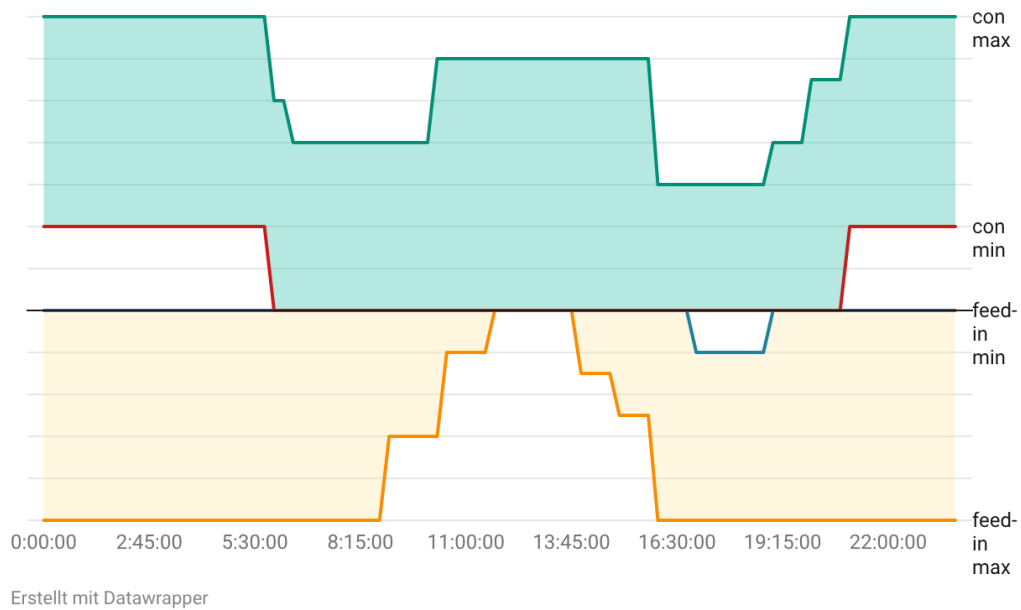


Figure 2 Schematic representation of an envelope

The transferred command is composed of a start time and slots. These slots contain the outer (con max / feed-in max) and inner (con min / feed-in min) limit as well as the duration. The slots should be set in the 15-minute interval, but technically this is not required. In the event of a communication failure, a fallback curve can be specified.

Infobox on the state of the art § 14a EnWG and § 9 EEG

Paragraph 14a EnWG for flexible consumption facilities and § 9 EEG for flexible generation facilities form the basis for grid-oriented control in low voltage grids. These paragraphs relate to charging points for electric vehicles, heat pumps, space cooling and electricity storage systems with a capacity exceeding 4.2 kW, as well as generation plants with a capacity exceeding 2 kWp. These systems are controlled either directly or via an EMS. A control unit (CU) of the MPO is used for this purpose. This is either a function part of the SMGW or in the form of a CLS adapter (Controllable Local System) connected to the SMGW. In the digitalization report published by the BMWF in 2025 (according to § 48 MsbG), the BET assumes that more than 18 million such control devices will be installed by 2032 (BMWi, 2025).

The technical design of the interface between the control unit (MPO) and the controllable system (operator) is described by the VDE FNN (FNN II, 2025) and serves as a uniform recommendation – in particular according to the definition BK6-22-300 of the Federal Network Agency with regard to tenor number 2a. There are basically two types of interface design, on the one hand digital control via EEBUS and on the other hand relais control in the form of potential-free contacts. The digital control is the clearly recommended target image and will be considered exclusively in the following. With the digital control via EEBUS, an expandable and thus future-proof solution is available, which is currently integrated into the processes and products across the industries. EEBUS is an open protocol of the EEBus Association, in the standardization of which many companies from the energy industry actively participate. For a standardised access of the authorised market players to the control unit of the responsible MPO, BDEW and the Federal Network Agency define the necessary standards. Decision BK6-22-128 established a basis for the first time (BNetzA III, 2022). The so-called universal ordering process is used for authorization management, while the standardised transmission of control commands takes place via the “API web services for the processual processing of control actions” (BDEW-API for short) (edi-energy, 2023).

If a distribution system operator (DSO) detects a congestion, it sends an ad hoc command to the responsible MPO via the standardised BDEW API. The latter passes on the command over his systems to the property to the SE. Here, the transfer of responsibility to the responsible plant operator takes place via the EEBUS protocol. To limit a consumption performance, the EEBUS use case “LPC” (Limit of Power Consumption) is applied. For the feed-in limitation, the use case “LPP” (Limit of Power Production) is applied (EEBUS Grid Use Cases). Both use cases thus represent an “ultima ratio” option for the distribution system operator in order to be able to intervene directly in his low-voltage network. EEBUS Grid Use Cases

Potential applications of the power envelope

Based on the prior art and the ongoing control rollout, the power envelope can offer a possibility of serving further energy-economic applications. In contrast to the curative ad hoc control, the envelope offers in particular the opportunity to ensure a proactive effect as well as a better integration of market and grid interests. The overarching goal is the more efficient use of infrastructure and the cost-effective integration of energy transition plants into the low-voltage grids. In the following, a brief overview of the possible use of the power envelope by the participating market roles will be provided. The perspective of the plant operator is not explicitly described, but is a central aspect that must be considered by all other market roles. The operator should have an advantage by using

envelope curves. Possible advantages are monetary compensation, the avoidance of restrictions by the application of § 14a EnWG / § 9 EEG and better transparency about the use of flexibility. Specifically, these result from the contractual relationship with the DSO or the marketer.

Use case / DSO perspective

Distribution grid operators are particularly challenged when implementing the energy transition, as a large part of the generation and consumption devices are connected in low voltage. Digitalisation and the proactive use of flexibility by DSOs can make a decisive contribution to keeping economic costs low and the speed of connecting further energy transition plants high. In order to achieve high efficiency among DSOs and at the same time high acceptance on the part of the plant operator, the curative instrument according to § 14a EnWG is to be supplemented by a proactive or preventive instrument. The required planning horizon lies in the “day-ahead” range, i.e. several hours before a possible bottleneck. The previous preventive instruments according to § 14a are unsuitable for the objective and have a long-term planning horizon. For example, cyclic control (preventive control according to § 14a) only allows a static power limitation of up to two hours a day until the end of 2028 – without prior metrological congestion determination. In order to improve the classification of the different instruments, the following figure is used:

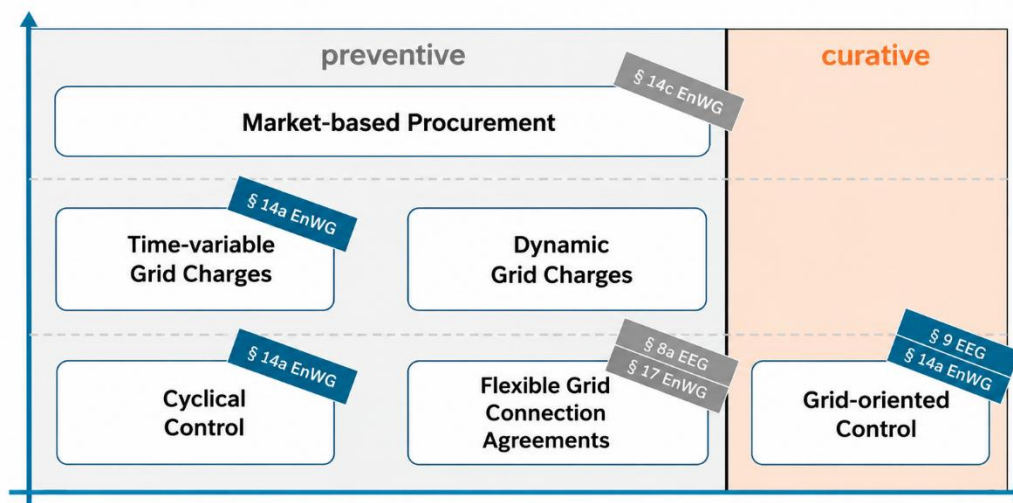


Figure 3 Overview of the most relevant low-voltage grid-oriented control tools.

The WARAN project and this document focus on the use of the envelope for market-based procurement and flexible grid connection agreements. Since no regulatory activities are foreseeable for market-based procurement, this instrument has initially moved into the background. Advantages are the connectivity to the curative control, the high flexibility and the reliable planning of the power envelope.

Motivation to participate / adhere to an envelope:

The envelope is to be used as a voluntary option for operators of controllable installations and in addition to existing mandatory instruments. In order for the instrument to have the desired effect, an incentive to participate is needed. In the following, a distinction is made between three participation options:

1. Voluntary participation without additional financial incentive:

In this variant, the actors participate free of charge in the preventive network-oriented control. Based on the offer of the DSO, to submit the power envelope and thus the expected network utilisation, operators can voluntarily adhere to it and behave in a grid-neutral manner. However, since operators do not receive remuneration, they are not obliged to comply with the power envelope. Advantages are essentially increased convenience through predictive optimisation and lower failure work during plant operation, since § 14a EnWG or § 9 EEG do not have to be used as a result of compliance with the power envelope. In addition, there is less interaction with market interactions, as potential grid congestion situations are known at an early stage and can be planned in the timetables and balance sheets of the suppliers. This creates better predictability on the part of the plant operator and the responsible marketer. Since voluntary participation is non-binding, there is no significant improvement in planning on the DSO side.

2. Flexible connection contracts:

Flexible connection agreements (or FCA for short) can be agreed between DSO and plant operator in accordance with EnWG § 17(2b) and § 8a EEG. FCAs can be particularly important for plant operators with a (bidirectional) battery/storage. As a result of the contractual obligation to implement the storage operation within a power envelope specified by the DSO and thus in a grid-neutral manner, it could be agreed, if necessary in coordination with the BNetzA, that the network charges for the intermediately stored electricity would be eliminated. This makes the business case much more attractive for the operator and for the corresponding marketers (FfE IV, 2025). The current consultation on the market integration of storage and charging points (MiSpeL) already defines the delineation and billing of intermediately stored electricity and stimulates bidirectional operation (BNetzA IV, 2025). A standardised FCA based on this could therefore offer a good opportunity to design the market integration in a grid-neutral manner at the same time.²

²The amendment to the EnWG (from 13 November 2025) and the related adaptation of § 118 (6) EnWG may eliminate the incentive for operators to carry out an FCA with a discount on network charges. It is therefore necessary to legally examine the approach and, if necessary, identify alternatives. For example, an agreement on the prioritized § 14a EnWG would be conceivable, in which customers with an envelope FCA would only be affected downstream by the emergency signals.

3. Incentive flexibility over network charges / Dynamic capacity prices:

In a target image, there is an incentive for network-neutral or network-service operation through the use of suitable network charging models. The ongoing BNetzA (BNetzA V, 2025) determination procedure is already working on a reform, so this paper does not go into any further detail about a possible design. However, it should be noted that the envelope instrument is in principle well suited to combine the financial incentive effect via network charges with the necessary and binding flexibility activation. It would be conceivable, for example, to use envelope curves in combination with network charge packages depending on the contractually agreed power class of the grid connection (unit-e2, 2024).

Summary of the DSO perspective:

In sum, there are various potential incentives to participate in a preventive DSO instrument and thus for grid-neutral integration of energy transition units through the use of an power envelope. The added value on the part of DSOs arises in particular if the power envelope achieves binding compliance and thus can also be taken into account in network planning. Therefore, in particular the contract-based variants 2 and 3 are recommended.

The comparatively simple adaptability of existing control processes and the possibility of iterative further development represent a great opportunity for the envelope concept. The concrete application of the power envelope can be designed flexibly and depends on the energy transition units affected or the energy demand of the property. The configuration can be static or dynamic. In particular, the inclusion of local forecasts (cf. EEBUS Grid Use Cases PODF) or automated demand planning on the EMS can contribute to an optimised control by the DSO. EEBUS Grid Use Cases

With the use of FCA's, a suitable possibility is already available in the current legal framework. Using standardised contracts can help simplify technical implementation and increase acceptance. FCA's are particularly suitable for an early start and learning phase. This learning phase is useful and recommended in order to orchestrate the mass integration of energy transition units efficiently and technically robustly and thus contribute to reducing the economic costs of the energy transition.

Flexibility marketing use case / supplier perspective

The increasing integration of decentralised, controllable systems (e.g. PV systems, storage systems, heat pumps and e-mobility) opens up new possibilities for energy suppliers and flexibility marketers to bundle flexibility and place it on the market. The technical implementation of the power envelope via the iMSys creates for the first time a standardised, secure and scalable control path that enables market-optimised use of flexibility via this infrastructure. In addition to network operators, marketers can also use

the secure and standardised way to optimize household flexibility without having to install their own hardware.

Flexibility marketing by energy suppliers

a) spotmarket

Timetable optimisation: By transmitting envelope curves to the EMS, the energy supplier can specifically control load shifts and feed-ins. Flexibility can be bundled and timetables optimised for marketing on the spot market. Flexibility can be used in response to price signals or forecast deviations. For the end user, this means that prices on the electricity market can be used to reduce electricity purchase costs by intelligently using unit flexibility.

In addition, the power generation or feed-in of PV systems or battery storage systems can be optimised in a direct marketing in such a way that this takes place only in time windows that take place according to market criteria, such as the predicted price on the spot market. Due to the ongoing consultation on the “market integration of storage systems and charging points” (short MiSpeL), it is expected that the direct marketing of generation plants in the power range of less than 100 kW or more can be expected And the segment of less than 30 kW gains in attractiveness. In addition to the feed-in limitation in time windows with low or negative prices, the targeted activation of feed-in at times with high market prices also plays a role. The power envelope offers a suitable instrument for both scenarios.

b) Physical Balancing Group Management

If the speed of the processes allows this via the iMSys infrastructure, the flexibilities for balance management can also be used. Flexibility is not called up on the markets, but at a time when these markets are already closed: in the quarter-hour. In the knowledge of imbalances in the acute quarter-hour, flexibility can be used to reduce imbalance costs. The final consumer is remunerated for the provision of flexibility.

c) Ancillary Services

System service minute reserve: Even if the balancing service minute reserve is a system service for a transmission system operator, it is still a market use of flexibility. The new minimum IT requirements of the TSOs also allow the aggregation of microsystems via an iMSys in order to participate in the balancing capacity bundled up to a maximum of 10 MW (regelleistung.net, 2025). Taking into account the current lead times, a prequalified participation in the reserve and balancing market is conceivable, since a centralised call of the marketed power is to be carried out with a few minutes lead.

Marketing models: Energy suppliers can offer different marketing models, e.g. dynamic tariffs, flexibility premiums or participatory models where operators are remunerated for

providing flexibility. In addition to flat-rate billing models, remuneration models (fixed amount per used kWh flexibility) are also conceivable here.

Summary: Energy Utility / Supplier Perspective

The integration of the power envelope as a standardised control instrument makes it possible to use flexibility both in a grid-service and market-optimised manner. Energy suppliers and flexibility marketers can thus develop new business models that address both the requirements of grid operation and the opportunities of flexibility marketing. The combination of technical standardization, regulatory opening (control power) and innovative marketing models make the envelope an attractive option, which exists in addition to the established proprietary control.

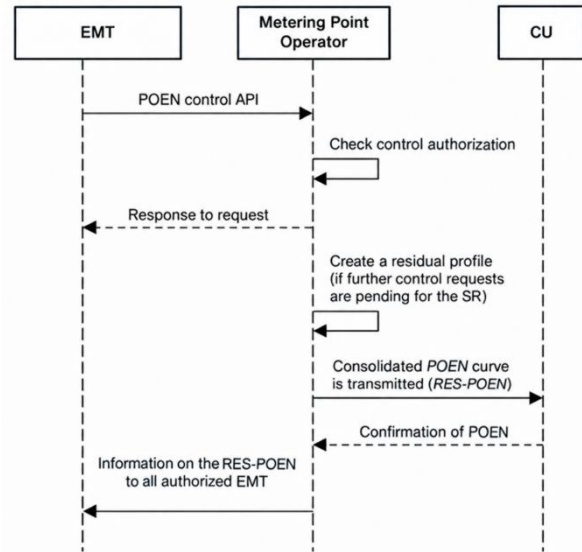
Use case / metering point operator perspective

The MPO ensures the operation of the secure, digital infrastructure and, in its role as control administrator, enables coordinated access to the flexibility. Due to the legal requirements, the MPO is obliged to enable not only the curative control but also the market control. In particular, the obligations under § 34 (2) MsbG and § 10b EEG should be mentioned, which make it necessary for the MPO to implement suitable control signals for system services and direct marketing from 2028 onwards. The envelope appears to be a suitable instrument for this purpose in order to meet the different requirements and to offer a standardised possibility of both specifying performance limits and specifically activating the supply or the feed-in.

The core task for implementing the envelope control is to receive the commands via a standardised API, carry out a validation and authorization check, resolve conflicts arising from different control interests and ensure communication to the property.

The standardised implementation of the envelope control requires in particular an extension of the API web services by the BDEW and a description of the technical implementation by the FNN. Within the framework of the WARAN project, proposals are developed and introduced into the discussion. In the following figure, a basic implementation of the envelope control via the MPO is outlined:

- The call of the “POEN-Control API” by the DSO or supplier (LF) only takes place if there is a specific need for control.
- The MPO checks the authorization and acknowledges the request accordingly (response of the request)
- If the DSO and the LF simultaneously send a controll request, the MPO forms a suitable residual profile.



- After confirmation by the local plant, the MPO sends the information on the resulting profile (RES-POEN) to all market partners involved.

FIG. 4: 4control via MPO FIG. 4: Envelope control via

For the coordinated and conflict-free transmission of the envelope, the formation of an envelope residual profile (RES-POEN) by the MPO makes sense. For this purpose, the concept for the residual profile described in the FNN-Note Control Administrator can be used and extended (FNN III, 2025). A residual profile provides for the consolidation of various control requests in the backend of the MPO and makes it possible to generate a harmonised profile based on authorizations and priorities. The envelope residual profile thus represents a logical further development to the residual profiles for the LPC and LPP control.

The following table gives an overview of how the processing of the individual curve components can look and which market partner is justified according to current assessment.

	Min. Power con min / feed-in min	Max. Power con max / feed-in max	Comment
Power envelope generation (POEN-)	Only supplier, adjustment in case of conflict to Max. Power is needed.	Residual profile (RES-POEN-)	Always 15 minutes slots. Residual profile assumes the smallest value in terms of amount
Power envelope Consumption (POEN+)	Only supplier, adjustment in case of conflict to Max. Power is needed.	Residual profile (RES-POEN+)	Always 15 minutes slots. Residual profile assumes the smallest value in terms of amount
Feed-in fallback curve (FB-)	Not defined	Residual profile (RES-FB-)	Configuration issue, i.e. no near-real-time control
Consumption fallback curve (FB+)	Not defined	Residual profile (RES-FB+)	Configuration issue, i.e. no near-real-time control

Further conflicts, for example with regard to ad-hoc control signals, are not necessarily resolved by the MPO, since a defined behaviour of the controllable installations is already described via the EEBUS application cases or the VDE-AR-E-2829-6-1. The curative emergency commands LPC and LPP always have a higher priority and must be adhered to accordingly if they conflict with the POEN control. The envelope control is therefore well distinguished from the emergency control and thus significantly improves the traceability and transparency on the operator side.

Application examples for power envelopes

The transmission and implementation of the power envelope is illustrated by three simple examples. The control of a property with EMS is considered. The property includes a heat pump, a wallbox, a battery storage and a PV system. The setup thus corresponds to one of the real field tests in the WARAN project. The envelopes are sent either by the DSO or the supplier. The MPO has previously established controllability by installing the technical infrastructure consisting of SMGW and control unit. In addition, he operates the systems necessary for the control, such as the control admin and the BDEW API. The operator is remunerated in accordance with his contract with the controlling party.³

Example 1: Prevention of network overload by DSO

The example in Figure 5 shows how a Figure 5 overload of the distribution network:

1. On the basis of its forecasts, the DSO notes that the next day's PV feed-in will cause a bottleneck in the distribution grid.
2. In order to avoid congestion, the DSO shall send an envelope on the feed-side to the MPO the day before. This is done via the BDEW API. The power envelope allows only a reduced feed power during the predicted PV peak.
3. This envelope is processed by the systems of the MPO and passed on to the SE via the control admin (ST-A).
4. The envelope is transferred from the control unit as EEBUS POEN to the EMS. If this was successful, the MPO receives a confirmation from the SE. He then informs the authorised EMT about the current envelope via the API.
5. The EMS takes the envelope into account in its optimisation: During the PV peak, the controllable systems may only feed into the grid with reduced power. So that the power generated at this time is not lost, the EMS reserves sufficient capacity in the battery storage. As a result, the battery storage can absorb the power produced during the PV peak and relieve the distribution network.

³The use cases and system architectures examined in WARAN are published here: WARAN

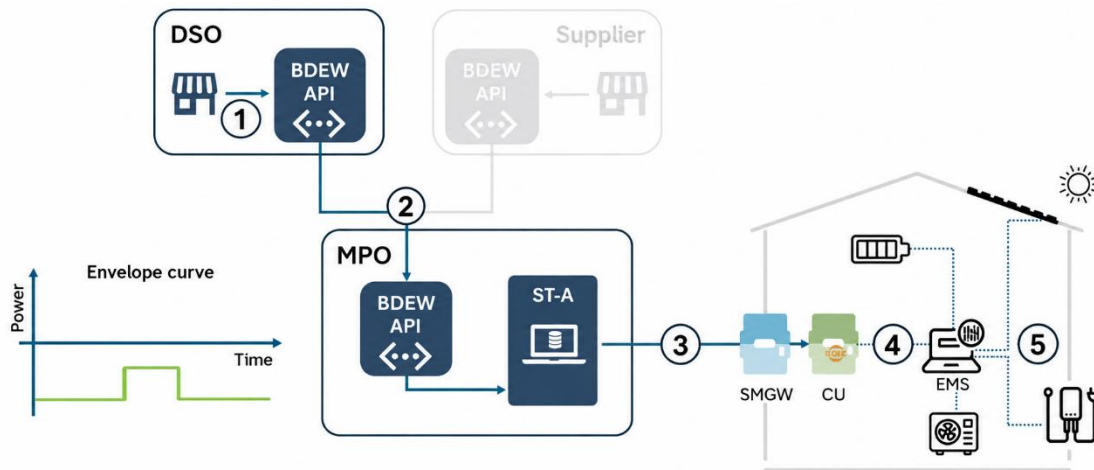


Figure 5 Diagram for example 1: Prevention of network overload by DSO

Example 2: Market optimisation by the supplier

The example in Figure 6 shows how a Figure 6 optimize its roadmap on the electricity market:

1. The supplier expects high prices on the spot market between 6 pm and 8 pm and wants to optimize its timetable accordingly.
2. The supplier then sends a consumption-side envelope to the MPO the day before. This is done via the BDEW API. The power envelope prescribes a reduced consumption between 6 pm and 8 pm.
3. This envelope is processed by the systems of the MPO and passed on to the SE via the control admin.
4. The envelope is transferred from the control unit as EEBUS POEN to the EMS. If this was successful, the MPO receives a confirmation from the SE. He then informs the authorised EMT about the current envelope via the API.
5. The EMS takes the envelope into account in its optimisation: it increases the power setpoints of the heat pump and the wallbox in order to prefer their energy consumption. This ensures convenience during the subsequent reduction and enables the supplier to follow his optimised roadmap.

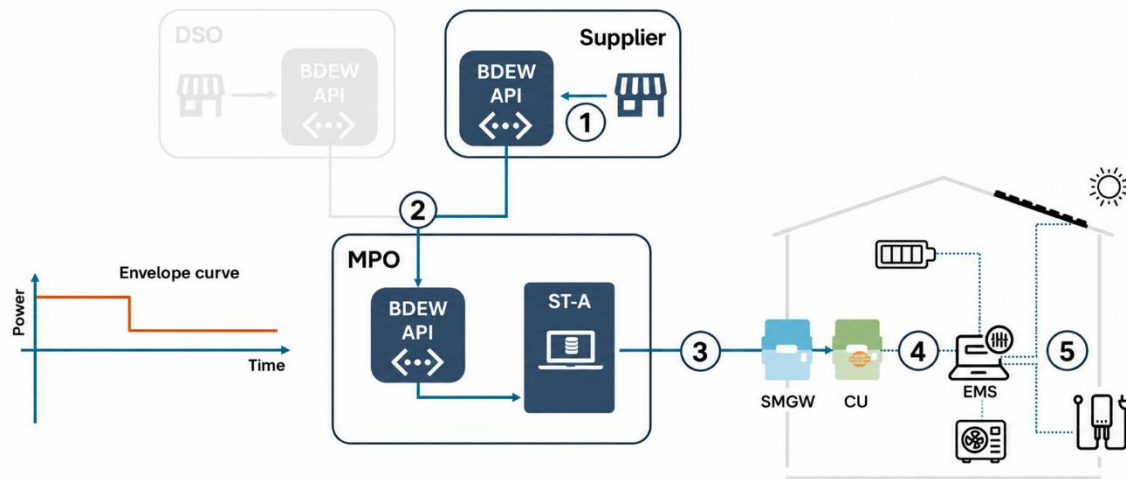


Figure 6 Diagram for example 2: Market optimisation by the supplier

Example 3: Interaction of DSO and supplier

The example in Figure 7 Figure 7 sent by the DSO and the supplier via the MPO to the EMS:

1. On the basis of its forecasts, the DSO states that the PV feed-in will cause a bottleneck in the distribution grid between 12 and 2 p.m. the next day.
2. In order to avoid congestion, the DSO shall send an envelope on the feed-side to the MPO the day before. This is done via the BDEW API. The power envelope allows only a reduced feed-in capacity of 50% during the predicted PV peak.
3. This envelope is processed by the systems of the MPO and passed on to the SE via the control admin.
4. The envelope is transferred from the control unit as EEBUS POEN to the EMS. If this was successful, the MPO receives a confirmation from the SE. He then informs the authorised EMT about the current envelope via the API. This is the supplier in this case.
5. The EMS takes the envelope into account in its optimisation: During the PV peak, the controllable systems may only feed into the grid with reduced power. So that the power generated at this time is not lost, the EMS reserves sufficient capacity in the battery storage. As a result, the battery storage can absorb the power produced during the PV peak and relieve the distribution network.
6. Now the direct marketer expects negative prices on the spot market between 1 pm and 3 pm of the same day. He wants the plant to feed no electricity into the public grid at this time.
7. It then sends an envelope on the feed side to the MPO. This is done via the BDEW API. The power envelope does not prescribe any feeding between 1 p.m. and 3 p.m.
8. This envelope is processed by the MPO systems. Since an power envelope already exists for the same time period and grid connection point, a residual profile is

formed therefrom. The two envelope curves are blended in such a way that the minimum value is transferred in each case: a 50% feed reduction from 12 to 1 p.m. and a complete reduction in feed from 1 to 3 p.m. This ensures that both envelope curves are maintained. The MPO then transfers these to the SE via the control admin. Step 4 + 5 is executed again.⁴

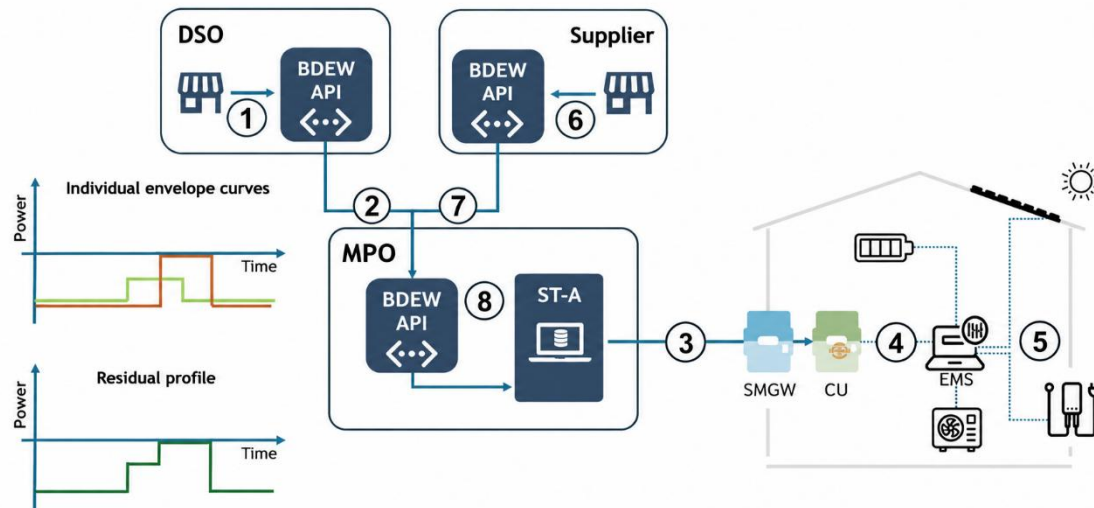


Figure 7 Diagram for example 3: Interaction of DSO and supplier

Outlook

More extensive involvement of market players in the iMSys infrastructure requires further aspects that need to be studied and discussed beyond this impulse paper. This paper already addressed the necessary further design of the “POEN-Control API”, which must be technically clearly described. In addition, the standardised transfer of type 2 measured values (TAF 9 and TAF 10) is also relevant in order to provide a good data basis for DSOs and market partners for the targeted application of the power envelope. In order to increase the quality of the data base, it would make sense to transmit a local forecast from the property to the DSO/market partner via the PODF (EEBUS Grid Use Cases) as a counterpart to the power envelope. These topics are already under further investigation in both the WARAN and SISSY consortium. EEBUS Grid Use Cases

Referring to the FNN note “Concept description for forecast-based control between network and market via iMSys and Flexband” from the beginning of February, the time limitation of the lead time for the transmission of envelope curves has not yet been conclusively examined from the perspective of the projects. The consortia agree with the view expressed in the FNN-Note that the envelope communication of the previous day

⁴How the envelopes are blended if the customer has a contract with DSO and marketer must be clarified in further discussions. This could, for example, be part of the Treaty.

should first be assumed. In the future, however, short-term underground changes are also relevant and should therefore be considered in practical testing.

Finally, the option of an energy roadmap as a market instrument complementing the envelope is also part of the project discussions. This would allow actors to transmit the quantities of energy traded on the spot market to the EMS as energy target values.

Conclusion

With this impulse paper, the joint project “Waran” shows how the control system has been further developed via the iMSys in order to cover both grid-oriented and market applications. At the same time, it contributes to the ongoing industry discussion around envelope concepts and market control via the iMSys and is intended to further stimulate them. The power envelope is located in the local prioritisation below the ad hoc emergency signal of the DSO. It is thus an instrument enabling both the DSO and other market players to use the existing iMSys infrastructure for market-based control intervention. In the outlined target, the DSO acts market-based by concluding contracts with plant operators for the use of flexibility and remunerating them accordingly. Other market players can use the same route by ordering controllability via the MPO, concluding contracts with plant operators and using the iMSys infrastructure to hand over control commands. The interests of the operator should always play a central role.

For suppliers and marketers, this results in significant advantages: they do not have to set up their own communicative connections to individual plants, but can fall back on the scalable, cyber-secure and standardised infrastructure of the MPO. The rapid scaling of the rollout represents the appropriate basis for this. In addition, the plants particularly relevant for marketing are made mandatory anyway via the iMSys infrastructure due to the requirements of § 14a EnWG and § 9 EEG. Since the target vision is consistently digital and EEBUS is the minimum standard for this, the implementation at plant, EMS and SE levels can usually be carried out by software updates. Additional installation trips, new hardware or rewiring are usually not required.

The economic benefits of developing budgetary flexibility are undisputed in the industry. In addition, the approach shown here via the intelligent measurement system addresses central topics such as safety and resilience, which must be considered in the design of our future energy system.

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Annex III

EEBUS Grid Use Cases

EEBUS Use Case	Abbreviation	Description
Limitation of Power Consumption	LPC	With the LPC, the power consumption of one or more installations can be limited to a predetermined maximum value. The aim is to smooth local load peaks in the power grid. The LPC is used as an instrument for § 14a EnWG cases.
Limitation of Power Production	LPP	With the LPP, the feed power of a generation unit into the network can be limited to a predetermined maximum value. The aim is to smooth local production peaks. It is used as an instrument for § 9 EEG cases.
Monitoring of Grid Connection Point	MGCP	The MGCP aggregates the consumption and generation values of a connection point and outputs them in absolute terms.
Monitoring of Power Consumption	MPC	The MPC indicates the power consumption of an installation at a given time.
Time of Use Tariff	TOUT	Via the TOUT, tariff information, for example of dynamic electricity tariffs, can be transferred and priced into a local optimisation.
Power Demand Forecast	PODF	The PODF outputs the expected power consumption of the plants of an EMS for future time intervals. The expected maximum and minimum values can also be transferred.
Power Envelope	POEN	The POEN passes maximum and optionally minimum power reference and generation limits for future time intervals within which an EMS can optimize the connected installations.

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List of abbreviations

CLS.....	Controllable Local System
EMSEnergy	management system
FCA.....	Flexible Connection Agreement
GW	Gigawatt
iMSysIntelligent	metering system
kW	Kilowatt
LFSupplier.....	
LPC.....	Limit of Power Consumption
LPP	Limit of Power Production
MPOMetering	point operator
PODF	Power Demand Forecast
POEN.....	Power Envelope
PVPhotovoltaics	
SEControl	unit
SMGW.....	Smart Meter Gateway
ST-AControl	administrator
TSOTransmission	system operator
DSODistribution	system operator