



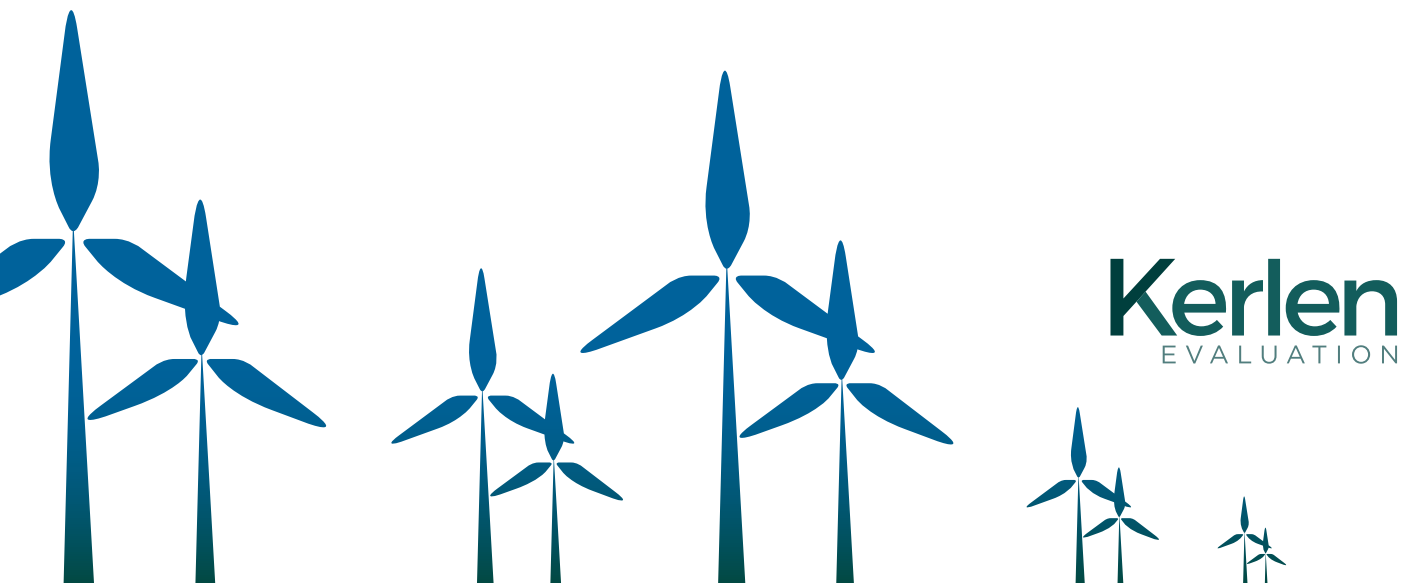
SINTEG

SCHAUFENSTER INTELLIGENTE ENERGIE

SMART ENERGY SHOWCASES – DIGITAL AGENDA FOR THE ENERGY TRANSITION (SINTEG)

EXECUTIVE SUMMARY OF THE
PROGRAMME EVALUATION

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Kerlen
EVALUATION

On behalf of:



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and Climate Action**

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EXECUTIVE SUMMARY

From December 2016 until the end of March 2021, the German Federal Ministry for Economic Affairs and Energy (BMWi)¹ funded the development and demonstration of scalable model solutions and blueprints for a secure, economical and environmentally friendly energy supply with high shares of wind and solar energy with the SINTEG funding programme „Smart Energy Showcases- Digital Agenda for the Energy Transition“. The experiences gained should also provide indications for the future development of the legal framework as well as norms and standards. In SINTEG, 303 companies, research institutions and other organisations were supported in five showcases. The showcases each covered several federal states in Germany and together covered almost the entire federal territory. 189 research and development projects, with total costs of around 334 million euros, were supported with federal funds amounting to almost 169 million euros.

Evaluation purpose and approach

The object and focus of the evaluation was the SINTEG programme, not the individual projects in the showcases. Thus, the results achieved by the programme at the level of participating companies, research institutions and other partners as well as the (potential) effects at the level of the overall system are at the centre of the considerations. The accompanying evaluation (2017-2022) conducted by Kerlen Evaluation was primarily intended to fulfil a learning function. The combination of accompanying evaluation, ex-post evaluation and regular reflections with key programme actors enabled the ongoing use of evaluation findings. With the funding of showcases, SINTEG also chose a relatively new funding approach to research and technology support. The task of the programme evaluation was therefore also to examine and assess this funding instrument.

The evaluation was theory-based and assessed SINTEG using the evaluation criteria of relevance, coherence, acceptance, effectiveness, appropriateness of procedures and structures, and efficiency. For this purpose, a multi-method and multi-perspective evaluation design was developed with four evaluation cycles. In addition to the analysis of data and documents and the participation in events, the core data collection methods used were key informant interviews (20-25 interviews per cycle) as well as four online surveys of all SINTEG stakeholders (response rates between 60 and 81 percent, for beneficiaries between 70 and 90 percent). Based on all findings obtained in the course of the evaluation, recommendations were given for transfer and continuing use of SINTEG results as well as for future showcase programmes.

Relevance and coherence of the programme

The SINTEG programme is a research and development support programme that aims to provide knowledge and solutions to achieve energy policy related goals. These include:

- ▶ to ensure the efficient and secure operation of the grid, even as large parts of the electricity generated are renewables-based
- ▶ to harness the potential of making the grid and the market more efficient and flexible

¹ After the 2021 parliamentary elections, the Federal Ministry for Economic Affairs and Energy (BMWi) was renamed the Federal Ministry for Economic Affairs and Climate Action (BMWK). Since the implementation of the programme and significant parts of the evaluation still fall under the BMWi, the ministry will continue to be referred to as such in the following text.

- ▶ to ensure that all players of the smart energy system work together in an efficient and secure manner
- ▶ to make more efficient use of existing grid structures, and
- ▶ to reduce the need for grid expansion in the distribution network.

The objectives of the SINTEG programme addressed the challenges of the energy transition that were considered highly relevant at the time the programme was set up (2015). The showcase approach focused in particular on the demonstration of solutions suitable for mass use. The development of model solutions and blueprints for technical, economic and regulatory challenges of the energy transition was seen as a central goal. This approach was innovative in the field of energy in 2015, as the entire system, including regulatory and economic aspects, was taken into account. SINTEG also supports the digitalisation of the energy sector, particularly in the area of smart grid development.

The profile of the programme was further defined by the different ideas and priorities of the showcases. Central to all showcases is the use of market- and grid-side flexibility potential as well as contributions to secure and efficient grid operation. However, the goal system of SINTEG, as well as the showcases, did not prove to be completely clear and redundancy-free. Changes in the goal system were discussed and taken up while the programme evolved. A common understanding was gradually developed. The originally formulated programme objectives remained, but they were reweighted by the „themes and core statements“, a document developed for the synthesis of the programme, and further objectives (regulatory sandbox, sector coupling, participation and acceptance) were added. From the evaluation's point of view, the development of SINTEG's goal system through the „themes and core statements“ represents an adaptation to the objectives and priorities of the showcases.

The SINTEG funding competition was very well received. Actors from all federal states were involved. The financial resources of the SINTEG programme were sufficient to fulfil the tasks of the five showcases. However, own and third-party funding from the participating partners (especially from large companies) in almost the same amount was an indispensable supplement. The federal funds of the showcases ranged from 25 million euros (DESIGNETZ) to 40 million euros (C/sells). The showcases were set up differently in terms of size and internal structure (for example sectors), which corresponds to the diversity of the tasks and solutions.

In addition to the showcase projects, accompanying research for the programme was funded with 10.917 million euros. This was intended to support the innovation processes and ensure a high visibility and broad impact of the programme. The change in the consortium of the accompanying research in 2018 had an aggravating effect on the programme and the transfer of knowledge, although the lack of services could be partially compensated for by additional activities of the BMWi and the showcases.

The energy transition in Germany has progressed much faster since 2015 than could have been foreseen at the time, as can be seen from the significantly higher shares of renewable energies in energy consumption and generation. Framework conditions, technologies, relevant topics and political will have changed. Compared to previous efforts on dealing with high shares of renewable energies, SINTEG is characterised by its cross-system approach, large-scale demonstration and the involvement of diverse stakeholders. Participants and external experts considered the programme to be very significant

for the energy sector, although its relevance has changed over time due to further scientific and technical findings and new external conditions.

The unique selling point of SINTEG compared to other existing federal and state funding programmes is the broad showcase approach of SINTEG and an ordinance that provides a temporary framework for experimenting. The SINTEG programme was the first large-scale regulatory sandbox in the German energy sector. The overarching and integrating approach that takes into account the relevant actors and their interdependencies, the initiation of cooperations and the visibility are characteristics that distinguish SINTEG from other funding programmes. At the time of the call, the programme was situated within the funding landscape without large overlaps. Other funding programmes have subsequently developed in the direction of cross-system issues of the energy transition. SINTEG was one of the pioneers.

Effectiveness

The showcases brought together all players in the energy system, selected providers of flexibilities, research institutions and universities as well as service providers in the energy sector. This has made it possible to cover the entire value chain. As an applied research and development programme, companies are the largest group represented. The involvement of transmission system operators and distribution system operators in particular is indispensable for carrying out large-scale tests in practice. Universities and research institutions together account for just under a third of the players.

Due to the great interest, after an increase in funding five instead of the originally planned two showcases could be funded. The five showcases have focused their research and development activities on the problems typical for their regions and have thus each developed their own profile. They have been well supported by political actors at the state level.

The SINTEG ordinance has provided an incentive for participation in SINTEG. A number of partners have participated in the showcases even without public funding only because of the prospect of being compensated for economic disadvantages resulting from the experiments.

For the vast majority of the actors involved, the funding was of great importance for the implementation of the project. The funding enabled the actors to implement the project at all or to mobilise a higher project volume. The deadweight is relatively low.

Most of the projects were successfully implemented from a scientific-technical point of view. The expansion of applied and basic knowledge was particularly significant. For the companies, results at higher technology readiness levels (technology validated or demonstrated in relevant environment, system prototype demonstration in operational environment) were particularly important. The research institutions were particularly successful in supporting the qualification of young researchers.

The most important result at showcase level is that model solutions were found that can advance the energy transition. 84 percent agreed with the statement that this goal was achieved to a very great or great extent. Progress in digitalisation and in demonstrating the applicability of the developed model solutions in practice was also achieved to a high degree. Achievement of the objective of introducing new products and processes to the market as a result of the showcase and an increase in acceptance

among the population for the use of renewable energies fell short of the original expectations. The SINTEG stakeholders had very high expectations of what they wanted to achieve and change. Regulatory framework conditions that make the deployment of what is technically feasible economically unattractive and provide too little incentive for innovation proved to be a stronger obstacle than originally assumed. With the introduction of NABEG 2.0, a regulatory decision was also made against flexibility platforms, which were one of the focal points of developments in SINTEG in a number of showcases. The lack of certified smart metering equipment also proved to be a factor that negatively influenced reaching goals. Within SINTEG, the application possibilities of secure ICT in the energy grid were to be tested. Since the mandatory roll-out started three years later than expected, far fewer devices were ultimately installed than planned. Although the functions of smart metering systems could be demonstrated, a large-scale roll-out trial did not take place.

When important parts of the accompanying research were discontinued in 2018 the programme was missing an important building block of its impact logic in the middle of its runtime – the identification and synthesis of blueprints should have already been carried out accompanying the programme. Last but not least, the Corona crisis left its mark. The last year of programme implementation was marked by the far-reaching contact restrictions imposed when the pandemic began in March 2020. A quarter of the programme actors reported noticeable negative effects on the exploitation of the project results.

From the expert team synthesising the results, a total of 56 blueprints were developed in the five focus topics „Sector Coupling“, „Flexibility Mechanisms“, „Digitalisation“, „Regulatory Sandboxes“ and „Participation“, into which more than 215 individual activities of the showcases were incorporated. Many of the results achieved in SINTEG cannot yet be directly implemented or transferred, but point to next steps on the path to the energy transition. Overall, the blueprints are considered to be highly significant.

If the prerequisites for the implementation of the blueprints are met, the blueprints of the scientific-technical focus topics in particular can contribute to the SINTEG objectives. Particularly high contributions are expected to ensuring the efficient and secure operation of the grid and to harnessing the potential of making the grid and the market more efficient and flexible. All five focal topics of the synthesis contribute to ensuring that all players of the smart energy system work together in an efficient and secure manner.

The reports of the expert team synthesising the results were published at a symposium in May 2022. The transfer of the SINTEG synthesis reports and the blueprints is thus still to come. The extent to which the SINTEG findings are actually taken up and can make a contribution to the energy transition and the digitalisation of the energy sector in the future can thus not be assessed within the scope of this evaluation.

Results for the beneficiaries

For a research and innovation programme, the first results that can be expected are, in particular, invention and diffusion effects. With the generation of new knowledge and skills and the approaches to their dissemination, these effects have occurred to a comprehensive extent. It can be assumed that

the diffusion of the content-related results will take place along the known paths (publications, transfer via heads, cooperations). In the case of SINTEG, a synthesis of the results was also carried out. The dissemination of the blueprints developed in the process can support the diffusion of the findings.

In addition to the development of new knowledge and know-how, the direct effects on the actors involved – companies and research institutions – include new or deeper cooperation, innovations, higher visibility and the derivation of new research approaches. Less pronounced are effects related to the reduction of business costs and faster market introduction. Innovations and the ability to innovate are a particularly important target and effect variable in research and development programmes. They have therefore been investigated in various ways. In the result

- ▶ the share of innovating companies in SINTEG is very high
- ▶ a clear direct innovation effect is discernible, and
- ▶ the quality of innovations (market novelties, international innovations) is high.

Some of the experts external to SINTEG perceived the innovations more as systemic innovations for the interaction of parts of the energy system and as incremental innovations. In contrast, the surveys revealed a high proportion of product innovations. It is possible that these innovations are not (yet) very visible to the experts. The development of overarching, systemic solutions was seen as a key approach of SINTEG and the showcases.

A particularly pronounced effect of SINTEG is the emergence and deepening of cooperations. These are seen both as an effect of participation in SINTEG and as an added value of the showcase approach. With regard to cooperation, the evaluation has shown that

- ▶ diverse cooperations have been established between the groups of actors involved (high density of cooperation)
- ▶ a significant proportion of the collaborations are at the strategic level, and
- ▶ cooperations have also been established between actors who have cooperated little in the past.

So far, the cooperations are being continued to a large extent and have already been institutionalised in some cases. According to the experts, important new cooperations for the functioning and change of the energy system have arisen in particular between the system operators at different levels. The new and improved cooperative relationships between system operators and academia are also considered important.

On the one hand, the effects of cooperation arise in the programme itself. The surveys consistently show that desired programme effects such as innovations or the economic exploitation of project results occur to a greater extent among cooperating actors. On the other hand, SINTEG actors expect further cooperation effects. These consist particularly in further joint research and development activities, in the acceleration of coordination processes, in the avoidance of undesirable developments and in the development of innovations.

The research literature shows that cooperations can lead to considerable innovation and economic policy effects. In particular, they can significantly support the rapid implementation of the energy

transition. In the view of the evaluation team, key prerequisites have been created for important areas of the energy system through the cooperation initiated in SINTEG.

Firstly, effects beyond the direct programme participants result from the diffusion of the new findings into the energy system and beyond. The proportion of companies and research institutions for which the use of project results is not foreseeable at present or in the future is comparatively low. In the case of SINTEG, moreover, a complex synthesis of the results took place at showcase and programme level. The resulting blueprints are considered to be highly relevant for the next steps of the energy transition. Their dissemination is still pending. The blueprint approach for integrating, condensing and weighting project results appears promising for the diffusion of knowledge and innovations.

Secondly, indirect effects can be expected from the economic exploitation of the results by participating companies and research institutions. At the time of the latest survey (spring 2022), one quarter of all participating actors were making use of the results in an economic way – mainly companies. Compared to other funding programmes, the economic exploitation is therefore rather high. Most of the exploitation has taken place since 2021, i.e. after SINTEG ended. The survey data show that further economic exploitation will take place in the coming years. The first monetary returns have already been generated. A further 15 percent of the companies expect economic exploitation in the next three years (2022-2024).

Follow-on effects can result, for example, from the use of data, from efficiency gains, for example through the digitalisation of processes, or from products and services for a more flexible energy system. These indirect benefits cannot yet be assessed.

Efficiency and value for money

A prerequisite for an assessment of efficiency is the fundamental suitability of the programme's structures and procedures. This appropriateness of the funding structures and procedures will therefore precede the actual examination of economic efficiency. It includes the examination of the showcase approach as the central instrumental approach of SINTEG as well as the monitoring of the programme (accompanying projects, project management agencies).

Overall, the showcase approach is suitable for the objectives pursued with SINTEG to develop and demonstrate systemic solutions. The central added value compared to conventional R&D funding lies in the establishment and expansion of cooperations and networks between a large number of actors and joint learning. It also leads to a higher visibility of the individual projects and the results. In particular, the visibility effects are in line with the concept of a „showcase“. The central challenges of the approach are related to the central advantage: The size and heterogeneity of the alliances make a stronger balance of interests necessary and increase the effort for communication and coordination.

In the multi-level governance of this showcase approach, the showcases are characterised by a high degree of autonomy. In order to steer the comprehensive constellation of actors in the showcases, distinct management competences are necessary. The showcase coordination teams were mainly responsible for coordinating and interlinking the content of the work packages and projects. They also contributed greatly to the orientation and commitment of the individual actors and projects to the showcase by developing a common narrative and vision.

The accompanying research was supposed to interlink the showcases with each other on strategic issues, support the transfer of results and the visibility of the programme, identify potential synergies between the showcases, bring together results and condense them into blueprints, and help shape the regulatory framework. Due to the discontinuation of large parts of the accompanying research, a number of deficits arose in the middle of the programme, especially with regard to accompanying programme-wide synthesis processes and programme management. With a high level of commitment on the part of all those involved, it was possible to partially close this gap. However, not all tasks could be compensated – due to a lack of capacities and because of role conflicts. The project management at programme level and the synthesis of results were newly tendered and started their work in 2019. As the most important accompanying project, the synthesis of results has produced blueprints that are considered significant for the next steps of the energy transition. However, a continuous accompanying synthesis work would have significantly facilitated access to the results in the showcases and coordination with the actors. The effectiveness of the programme's accompanying research thus fell short of expectations.

Satisfaction with the funding procedures is high overall. In the application phase, there is generally a high level of satisfaction with the execution, but a period of around 1.5 years between submission of outlines and start of funding is too long. Overall, almost 70 percent of respondents rated the time and effort involved in the application phase as appropriate in comparison to the amount of funding awarded. The assessment of the funding procedures during programme implementation is predominantly positive. The support provided by the staff of the agency was particularly praised. In the overall assessment, the requirements for the administration of the project are judged to be appropriate in comparison to the amount of funding.

The execution agency ratio (executing agency costs in relation to the total expenditure for the programme) is comparable to other funding programmes and can be considered appropriate for a new programme with heterogeneous actors. The costs for accompanying research are also within a range comparable to other programmes with comprehensive accompanying activities. However, they have increased significantly due to the change of contractors.

The extent to which SINTEG provided value for money with regard to overarching objectives can be discussed qualitatively along the dimensions of scientific, economic, ecological and political-administrative benefit. In this context, the comprehensive innovation activities, the economic exploitation and ecological potentials suggest that a pronounced benefit is justified. The results of SINTEG could become even more important in the future against the background of current requirements (substitution of fossil energy sources to achieve climate goals and security of supply). The costs are not considered too high in view of the comprehensive approach and in comparison to other programmes.

Recommendations

On the basis of the evaluation results, recommendations were given for transfer and continuing use of SINTEG results, for the design of complex funding programmes in general and for conditions for successful showcase or regulatory sandbox programmes.

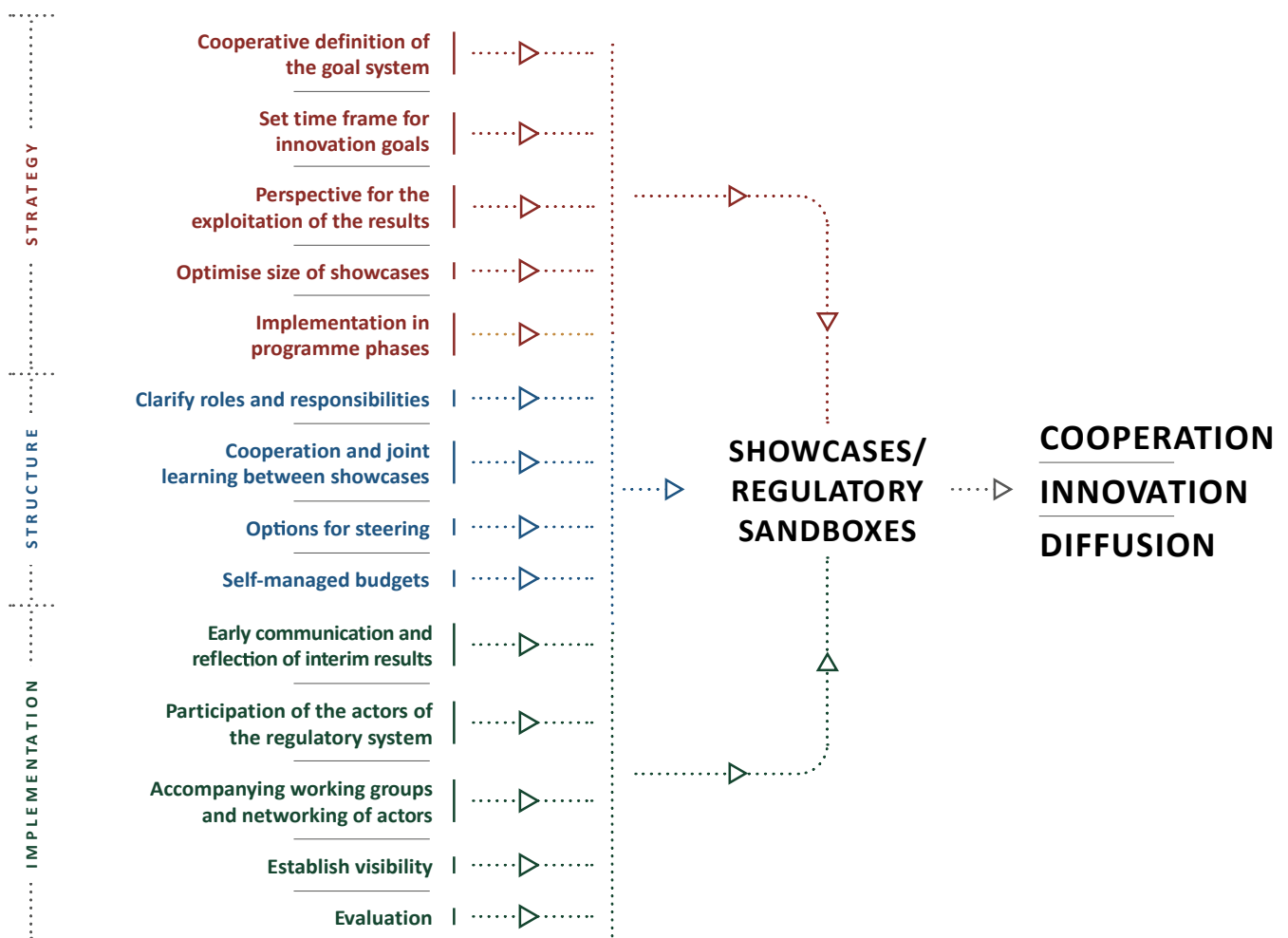
Support the transfer and use of SINTEG results

- |.....▷..... Adopting SINTEG results in changes to the regulatory framework
- |.....▷..... Actively transferring blueprints
- |.....▷..... Accompanying diffusion
- |.....▷..... Making demonstrators and test environments accessible

Better design of complex funding programmes

- |.....▷..... Develop goal system
- |.....▷..... Clarify understanding of key terms
- |.....▷..... Shorten the duration of the application phase
- |.....▷..... Enable agility and keep an eye on risks

Conditions for successful showcase or regulatory sandbox programmes



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