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Sustainability assessment of out of-of-home meals: potentials and obstacles applying indicator sets NAHGAST Meal-Basis and NAHGAST Meal-Pro

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ABSTRACT

Since human nutrition is responsible for about 30 % of the global natural resource use and in order to decrease resource use to a level in line with planetary boundaries, Lukas et al. (2016) proposed a resource use reduction in the nutrition sector by a factor 2 (Material Footprint).

The catering sector needs clearly defined indicators to assess their business activities' impact on ecology, social aspects, economic value, and health status. Within the project NAHGAST two sets of indicators, called NAHGAST Meal-Basis and NAHGAST Meal-Pro were developed. The indicator sets are proposed to measure several, with sustainability-associated challenges, such as such as the ecological, social and economical effects, which may come along with the production and the consumption of a meal. Basically, the NAHGAST Meal-Basis deals with qualitative indicators, such as the amount of organic food per serving or the percentage of food wasted. This set is supposed to enable leaders to assess the sustainability of their meals and to visualize future improvements on a simplistic level. The NAHGAST Meal-Pro deals with a more sophisticated set of indicators, such as the carbon and material footprint or the cost recovery per meal. Both sets are underpinned with sustainable targets and elaborated as an Excel-based assessment tool, which is tested within a one-year case study. The usefulness and the limits of the tool, as well as current results of the implementation including proposed challenges, are discussed.

***Keywords**: sustainability, nutrition, sustainability assessment, out-of-home*

1 Introduction

By offering sustainable – or at least "more sustainable" – meals, the out-of-home catering sector has the potential to implement the concept of "sustainable development" into the consumers' everyday life (Leitzmann 2014). Besides technical improvements and a reduction of food losses in the food chain, diet shifts offer practi-

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cable opportunities to reduce environmental impacts in the agro-food sector. To improve these aspects, it is necessary to analyze the sustainability status of the dishes.

Within this paper, we focus on the measurement tool developed within the NAHGAST project and discuss the theoretical and practical challenges that came within the implementation of the NAHGAST meal assessment tool consisting of two indicator sets. Thus, we will outline the debate about sustainability in nutrition and the indicators we have chosen to operationalize it (section 2). This section briefly refers to the results of earlier phases of our NAHGAST project as presented in Lukas et al. (2016). In the following section 3, the methodology is presented and the functioning of the tool is described. The fourth section points out preliminary results of the tool's implementation into practice and reflects challenges. The conclusion summarizes the discussion and gives an outlook on further steps and research needs (section 5).

The paper is led by the following research questions:

- *How can certain indicators and sustainable levels be integrated in a convenient tool to assess impacts of foodstuffs and diets and improve its sustainability?*
- *How can scientists realize the claim to offer a tool that can be used by practice partners without support? Is it sensual to divide the tool into two indicator sets with different complexity?*
- *What are the major challenges for a successful implementation of the NAHGAST tool?*

2 Background

„Environmental sustainability means improving our lifestyle in order to maintain natural capital." (Goodland 1997: 190) Within our lifestyles, individual nutrition plays a major role. Furthermore, diets link environmental and human health. Therefore, nutrition was and is a major focus area with high improvement potential to foster a more sustainable society. Rising incomes and urbanization as well as the trend to eat of out of home drive a shift away from traditional diets toward diets higher in refined sugars, refined fats, oils, and meats (Tilman & Clark 2014). In this context, the sector of out-of-home catering is a high-potential setting for designing and creating change. In the NAHGAST project, these potentials are reflected with several practice partners. In this effort of creating a more sustainable out-of-home catering, a transdisciplinary research approach is pursued.

As described in Lukas et al. (2016), the concept of an ecologically friendly diet is not new. Leitzmann mentioned the concept of „sustainable nutrition" in the 1970's. Within the last years, a lot of research has been carried out about health recommendations, which are linked to environmental change. Additionally, some research displays the complexity to give such integrated recommendations, also due to the fact that production and consumption patterns vary a lot within several countries (Vieux et al. 2013; Tom et al. 2015).

Nevertheless, science has yet to develop reliable instruments for measuring and benchmarking sustainability of food, which are available to end-consumers as well as to businesses in the out-of-home catering.

Therefore, the NAHGAST project proposes an indicator set, which will be publicly accessible[1], to easily display the sustainability of a meal.

The NAHGAST meal-assessment tool consists of two modules using different indicator sets: NAHGAST Meal-Basis and NAHGAST Meal-Pro. The tool was developed based on desk research and elaborates existing multi-criteria assessment methods as well as relevant research on selected issues within the four dimensions ecology, society, economy, and health. The indicator sets have been developed and discussed in several project workshops and expert meetings. Assessing a number of about 100 meals tested the preliminary sets of indicators.

[1] At the end of the project in 2018.

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Table 1 provides an overview, which indicators have been chosen for the NAHGAST indicator sets to assess meals:

Table 1: Overview of NAHGAST indicator sets to assess meals

	Ecological aspects	Social aspects	Health aspects	Economical aspects
NAHGAST Meal-Basis	• Share of animal products • Share of seasonal products (based on available seasonal products) • Share of regional products • Share of organic products • Use of GMO-free products • Share of sustainably caught fish products • *Share of avoidable food waste*	• Share of fair-trade products	• Energy content (kcal) • Amount of fruit and vegetables • Fibre content • Warm-keeping time of meals	• Popularity • Cost coverage ratio
NAHGAST Meal-Pro	• Material Footprint • Carbon Footprint • Water consumption • Land requirement • *Cumulative energy demand* • *Influence on biodiversity*	• Share of fair-trade products • Share of animal products from appropriate animal husbandry	• Energy content (kcal) • Fat amount • Amount of carbohydrates • Thereof: amount of sugar • Fibre content • Salt amount	• Popularity • Cost coverage ratio

The Basis set consists currently of 12 indicators, i.e. 6 ecological indicators, 1 social indicator, 3 health indicators, and 2 economic indicators. Additionally, we included the aspect of food waste but did not apply the indicator (*share of avoidable food waste*) yet. This will be discussed when results of the food-waste assessment (collection of primary data at several business partners) is finished. The Pro set currently consists of 14 indicators, i.e. 4 ecological indicators, 2 social indicator, 6 health indicators, and 2 economic indicators. Additionally, we discuss also including the aspect of *energy demand and biodiversity*. Six of these indicators are applied in both sets.

3 Methodology

The assessment tool is technically realized in form of an Excel file. For every meal to be assessed, a separate file has to be created. With that file, each meal can be assessed with both modules – NAHGAST Meal-Basis and NAHGAST Meal-Pro. For each module, there is a spreadsheet for entering the meal-related data (spreadsheet 1 for NAHGAST Meal-basic, spreadsheet 3 for NAHGAST Meal-Pro), and a spreadsheet showing the results (spreadsheet 2 for NAHGAST Meal-Basis, spreadsheet 4 for NAHGAST Meal-Pro). Another spreadsheet hosts the database for the calculations (spreadsheet 5).

In spreadsheet 1, the following data have to be entered:

- *Recipe information (all ingredients of the recipe and the amount in grams)*
- *Several ecologic, social and health-related qualitative indicators (yes/no)*
- *Two health-related quantitative indicators (amount)*
- *Some additional general and economic information*

In spreadsheet 2, the data of sheet 1 (e.g. 30 % of the ingredients are farmed organically) are related to sustainable levels that have been defined (e.g. at least 40 % of the ingredients should be organic; about the defini-

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tion of sustainable levels see section 2). Hence, for each indicator the meal can be categorized as "recommendable", "restrictively recommendable" or "not recommendable". This verbal information is also translated into numerically coded information ("recommendable": 3, "restrictively recommendable": 2, and "not recommendable": 1). These (discrete) numbers on indicator level form the basis for the calculation on the level of the different dimensions as well as of the total result (1 to <1,5 means "not recommendable", 1,5 to <2,5 means "restrictively recommendable", 2,5 to 3 means "recommendable"). Colour coding emphasizes the verbal and numerically coded information (green for "recommendable", yellow for "restrictively recommendable", red for "not recommendable".

Spreadsheet 3 principally works like sheet 1, with the difference that in NAHGAST Meal-pro, the ecologic and health-related indicators are quantitative ones. Furthermore, the ecologic indicators are linked with the data in sheet 5 so the ecological impacts of 100 g beef, for example, can be calculated automatically. The ecological indicators consider the ecological impacts of the ingredients themselves, of their transportation and of their storage.

Again, spreadsheet 4 works exactly like sheet 2.

Implementation of the NAHGAST meal-assessment tool

The NAHGAST meal-assessment tool serves the assessment of sustainability in dishes. In the NAHGAST project, several dishes have been matched between the practical partners: Divided in ten different meal categories (Schnitzel, Stew etc.), respectively two to three comparable dishes have been defined to be objects for interventions (e.g. recipe optimizations, like a reduced amount of meat or an increased share of seasonal products) for each partner

After having defined the indicators for NAHGAST Meal-Basis and NAHGAST Meal-Pro, having developed the assessment tool by an inter-organisational and interdisciplinary working group and having selected the "intervention dishes", the tool was refined iteratively by testing it with several dishes. Once the tool seemed to be methodologically sound, the concerted "intervention dishes" were assessed in a period of about two months in 2016. During this process, some potential for optimisation attracted attention so the tool was continuously refined – and became object of extensive discussions that are described in the following subchapter.

Discussions about the NAHGAST meal-assessment tool

Final indicators

Some of the indicators chosen are quite easy to handle, e.g. organic products. Other indicators – especially ones without clear and admitted labels – needed to be defined properly and possibly "calibrated". For example, the indicator *share of seasonal products (based on available seasonal products)* is sensitive to the time of its use. At one point in time an ingredient might be seasonal, at another point in time it might not be. Furthermore, it had to be clarified, whether or not deep-frozen or canned vegetables, due to their nature, can be purchased seasonally and whether or not they ought to be substituted with fresh (seasonal) vegetables if available.

Beyond these discussions, for some of the chosen indicators, finding data to enter into the Excel sheets was hard to locate. Partially, data is hard to gather because the business partners delivering the information regarding the meal components do not want to release information (e.g. the exact cost coverage) or they do not manage and monitor them (e.g. avoidable food waste). Other data is missing because of the non-transparent supply chains caterers are facing: Even big gastronomic suppliers cannot give valid information about the exact origin of many products (apart from this, the origins of many products vary during the course of the year). Nevertheless, all of the chosen indicators remained in the tool because they were seen as important, but some

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indicators were "inactivated" and excluded from the calculation as long as they cannot be managed properly.

Results: generation, aggregation, weighting, presentation

As described above, results are generated by relating the data of the meal (sheet 1 resp. 3) to the sustainable levels defined by the team (sheet 2 resp. 4). For the mostly qualitative indicators of NAHGAST Meal-Basis there is no problem, but NAHGAST Meal-Pro is demanded to calculate preferably exact nutritional and environmental impacts. This implies that a solid data basis is needed. Such a data basis almost completely exists for the nutritional indicators because for nearly every ingredient the nutritional key aspects are available in generally accessible databases. Unfortunately, this abundance does not exist for ecological data. In the accessible databases like ecoinvent, many products are not listed/recorded and need to be substituted with other products, which are as similar as possible. Moreover, the products listed in the databases are not sufficiently nuanced to display the different possible characteristics of a product, e.g. whether a tomato is grown seasonally, organically and open-landed or produced in a heated greenhouse – this can have vast effects on ecological indicators like the carbon footprint as shown in table 2. So, severe uncertainties are part of the assessment and for many products the results must be seen as approximations.

Table 2: Database examples for tomato production

Database examples for tomato production	kg CO_2eq/ kg tomatoes
Conventional, regional, non-seasonal farming in heated greenhouse	9,3
Organic, regional, non-seasonal farming in heated greenhouse	9,2
Flight ware from the Canaries	7,2
Conventional farming in non-heated greenhouse	2,3
Free range tomatoes from Spain	0,6
Conventional, regional, seasonal farming	0,085
Organic, regional, seasonal farming	0,035

Source: Gießen University, Ökologie und Landbau: Data from Pendos CO_2 calculator (2007)

Another question remains about the quantity and aggregation of information. For catering enterprises, a certain amount of differentiated information is essential to be able to improve their products on the basis of the assessment, but the information also needs to be compact and easily graspable. This applies all the more for customers who need to make a quick decision at the point of sale. We have decided to show the following information for the catering companies:

Level of information:

- all indicators separately
- sustainability dimensions (ecology, health, society, economy)
- total evaluation

Type of information:

- the numerical coding (1, 2 or 3 on the level of single indicators resp. average values on the level of dimensions or for the total evaluation)
- the appertaining verbal information ("not recommendable", "restrictively recommendable" or "recommendable"
- the appertaining visual information (red, yellow or green)

For now, we have decided not to give more weight to some indicators (or dimensions) than to others. We will decide this question during the further implementation and evaluation of the tool.

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For the customers, all the mentioned information would be overcharging so (all the mentioned types of) information should only be presented on the level of sustainability dimensions and possibly a total evaluation, too.

It is not a trivial task to decide on the format in which the information regarding a dish's sustainability performance is presented to the end-consumer. This issue is discussed in Langen et al. 2017.

Why the tool consists of two modules

The idea of splitting the tool into two modules was to give the practical partners and other catering institutions a simple, qualitative indicator set which can be used by themselves without further assistance by researchers (NAHGAST Meal-Basis). On the other hand, for a more detailed and impact-oriented assessment they could make use of the support of scientists, who would calculate the meals' diverse ecological and health-related impacts (NAHGAST Meal-Pro). This idea was based on the assumption that qualitative indicators like organic products are easier to understand and to deal with than impact indicators like carbon footprints.

Having built the Excel file, it became clear that NAHGAST Meal-Pro, with its quantitative indicators is – technically in terms of data input – not more complicated than NAHGAST Meal-Basis. The team was indeed able to integrate the data essential for the calculations and to automatize the filling in of most of the cells. Support from scientists becomes in this way not really necessary. On the other hand, we did not find a way to create an automatized linkage between our tool and enterprises' ERP (enterprise resource planning) systems, so several data (the ingredients, the dropdown list for the selection of the types of ingredients, and some binary-coded (yes/no) indicators) still have to be entered manually. This means that to deal with NAHGAST Meal-Basis and -Pro needs more time than kitchen managers might be able to invest (about 15 minutes per meal, if the user is already familiar with the tool).

Another assumption was that both modules lead to very similar results as the qualitative indicators like seasonal, regional, or organic products have (more or less) strong effects on other impacts like the carbon or material footprint. This assumption appeared as partially wrong, because some results of NAHGAST Meal-Basis differed quite widely from the results of NAHGAST Meal-Pro. This implies that correlations between the qualitative and quantitative indicators should not be assumed too simple or even deterministic, although these correlations of course exist.

In this context it is important to emphasize that the qualitative indicators are more than an intermediate step towards the quantification of impacts but have an own value so they should certainly not be left aside. To accent this distinct value and to avoid a too extensive data sheet, we decided to go on with two modules.

4 Current results

Here we present an overview of the overall scores of the assessment in NAHGAST Meal-Basis and NAHGAST Meal-Pro. Table 3 shows the results of the assessment of about 100 meals for each of the analysed 10 meal categories. We depict minimum and maximum scores of both sets, showing the differences of specific meals within a meal category.

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Table 3: Overall score of meals by meal category and NAHGAST Meal indicator set

Meal category	NAHGAST Meal-Basis		NAHGAST Meal-Pro	
	Min. score	*Max. score*	*Min. score*	*Max. score*
1. Stew				
• With meat	1.8	2.6	2.2	2.7
• Vegetarian	1.8	2.6	2.3	2.8
2. Spaghetti				
• With meat	1.6	1.7	2	2.4
• Vegetarian (1 option)	/	2.3	/	2.7
3. Lasagne				
• With meat/fish	1.4	1.7	1.7	2.4
• Vegetarian (1 option)	/	2	/	2.5
4. Potatoes (Only vegetarian options)	1.7	2	2.1	2.3
5. Chicken	1.4	2.2	1.6	2.5
6. Cutlet				
• Meat	1.2	1.7	1.6	2.2
• Vegetarian/vegan	1.8	1.9	1.8	2.6
7. Sausage	1.2	2.1	1.9	2.2
8. Goulash				
• With meat	1.3	2.3	1.8	2
• Vegetarian	2.2	2.4	2.7	2.8
9. Fish	1.9	2.4	2.3	2.5
10. Vegan/vegetarian casserole	2.1	2.2	2.2	2.8

Score scale: from 1 to 3 where: < 1.5 = not recommendable; ≥ 1.5 and < 2.5 = restrictively recommendable; ≥ 2.5 = recommendable. state Dec 2016

From these first results it can be noted that, generally speaking, NAHGAST Meal-Pro scores are higher than those of Meal-Basis, and that vegetarian/vegan meals score better - i.e. result to be overall more sustainable – than meat-based ones.

Also, the differences within the same indicators set (min. and max. scores) are higher for the following meals (mostly meat-based): stew; lasagne with meat/fish in Meal-Pro; chicken; cutlet (apart from the vegetarian option in Meal-Basis); sausages in Meal-Basis; goulash with meat; fish in Meal-Basis; vegan/vegetarian casserole in Meal-Pro.

Illustration

Below, the tool is illustrated by the assessment of a fictive example, a beef goulash. The dish consists of 11 ingredients with a total weight of 487 g:

- Beef goulash (haunch; fresh, chopped) 150 g
- Onions (cubes, deep-frozen) 10 g
- Sun flower oil 10 g
- Goulash base 5 g
- Corn flour 2 g
- Salt 2.75 g
- Mixed spices 1 g
- Long grain rice loose 60 g
- Drinking water 120 g

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- Mixed vegetables (deep-frozen) 120 g
- Olive oil 6 g

With this combination of ingredients, most of the indicators miss the defined targets (e. g. share of animal products, amount of fruit an vegetables etc.) so the result is rather mediocre (NAHGAST Meal-Basis 1.6; NAHGAST Meal-Pro 1.8 – that means: (barely) restrictively recommendable) (Table 4 and Table 5).

Table 4: Extract from the result spreadsheet of NAHGAST Meal-Basis (source: own work)

	Indicators – NAHGAST Meal-Basis													
	Ecology							**Social issues**	**Health**			**Economy**		Weight of the ingredients (g)
	Share of animal products	Share of seasonal products ...	Share of regional products	Share of organic products	Share of GMO-free products	Share of sustainably caught fish	Share of avoidable food waste	Share of fairtrade products ...	Share of fruit and vegetables	Energy (kcal)	Fibre (g)	Popularity	Cost coverage	
	31%	**0%**	**25%**	**0%**	**69%**	**0%**	**10%**	**13%**	**27%**	**605**	**5,9**	**level 2**	**level 2**	**487**
Sustainable level:	< 30 %	> 90 %	> 50 %	> 40 %	100%	100% MSC or ASC or no fish	< 10 %	> 90%	> 40 %	< 670 kcal	> 8 g	level 3	level 3	
Results (1, 2, 3):	2	1	1	1	1	3	2	1	1	3	1	2	2	
Results (recommendations):	restrictively recommendable	not recommendable	not recommendable	not recommendable	not recommendable	recommendable	restrictively recommendable	not recommendable	not recommendable	recommendable	not recommendable	restrictively recommendable	restrictively recommendable	**total score 1.6**

Table 5: Extract from the result spreadsheet of NAHGAST Meal-Pro (source: own work)

	Indicators – NAHGAST Meal-Pro													
	Ecology				**Social issues**		**Health**						**Economy**		Weight of the ingredients (g)
	Material Footprint (kg/meal)	Carbon Footprint (kg/meal)	Water demand (kg/meal)	Area required (m^2*a/meal)	Fairtrade	Animal Welfare	Energy (kcal)	Fibre (g)	Fat (g)	Carbohydrates (g)	Thereof sugar (g)	Salt (g)	Popularity	Cost coverage	
	9,61	**2,39**	**169,38**	**2,59**	**13%**	**0%**	**605**	**5,9**	**24,8**	**58,2**	**6,1**	**3,4**	**level 2**	**level 2**	**487**
Sustainable level:	< 2,67 kg/meal	< 0,8 kg/meal	< 640 kg/meal	< 1,25 m2*a/meal	> 90%	> 60%	< 670 kcal	> 8 g	< 24 g	< 90 g	< 17 g	< 2 g	level 3	level 3	
Results (1, 2, 3):	2	1	1	1	1	1	3	1	2	1	3	1	2	2	
Results (recommendations):	restrictively recommendable	not recommendable	not recommendable	not recommendable	not recommendable	not recommendable	recommendable	not recommendable	restrictively recommendable	not recommendable	recommendable	not recommendable	restrictively recommendable	restrictively recommendable	**total score 1.8**

With some modifications that don't change the dishes' nature (e. g. organic, fair trade, and regional ingredients), the results get slightly better. For distinct improvements, more substantial changes are necessary, e.g. the reduction of the meat share, more (and seasonal) vegetables and, if possible, other meat than beef (pork and chicken have lower requests of water, area and material and cause less greenhouse gases). With such interventions into the recipe, the total results of the assessment can reach up to 2.8 (in both NAHGAST Meal-Basis and Meal-Pro), which means "recommendable".

Consequences of the food assessment for NAHGAST interventions

Within the NAHGAST project, we perform several interventions in cooperation with our practice partners to influence individual food choices in out-of-home settings. For example, we are going to label the results of the sustainability assessment of the dishes (kind of intervention: information) and we replace the "most sustainable" – best-assessed – dishes to the most frequented counter (kind of intervention: nudging)[2]. For both mentioned interventions, the sustainability assessment of dishes with NAHGAST Meal-Basis and NAHGAST Meal-

[2] For more information on the NAHGAST interventions see Langen et al. 2017.

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Pro is essential. It allows us to assess – and label – selected meals in our "intervention weeks", and it enables us to identify the most sustainable dish(es) so these dishes can be objects of privileging nudges and further recipe optimizations.

Challenges for the implementation

The tool is consistent in itself, but it is not linked to several tools, which are used within the companies, especially the ERP systems (or maybe less sophisticated order systems). Automatically linked to an ERP system, the need for manual entries in the Excel files would decrease radically. Since the different companies use very different ERP (or similar) systems, the technical realisation of such an attempt would go beyond the scope of the NAHGAST project and may be a task for a following project.

Although we tried to design the tool as user friendly as possible, it is necessarily quite complex so it has to be explained by the scientists. For introducing the kitchen staff into several applications, different activities, such as performing a webinar, are possible.

Both mentioned challenges concern the effort the users must bring up to apply the tool. Potential users are usually working to capacity, so the most challenging aspect to overcome is that sustainability assessment is seen as extra work. The tool has to be resource efficient: easy to use without high cognitive effort and not time-demanding. To ensure this, one pilot study is not enough, thus, a longer test period is warranted. But it also has to be mentioned that the scientific validity must not take a back seat to the practicability – and the validity is a major challenge in itself because operationalising sustainability is a very complicated endeavour that necessarily means making oneself vulnerable to any kind of criticism.

5 Conclusion

After integrating ecological, health-related, social and economical indicators into a meal assessment tool, which consists of two sets – NAHGAST Meal-Basis and Meal-Pro – and after testing the described NAHGAST Tool on a large number of meals, we are able to identify the more and the less sustainable dishes and to test potential consequences of possible recipe interventions (e. g. sourcing seasonal, regional, organic, fairtraded products, reducing certain ingredients with high ecological impacts or replacing them with alternative ones).

However, we are aware of the challenges for a widespread implementation in practice. Major challenges for business partners are the effort to use the tool, the need for having (at least basically) a knowledge base that allows to fill in data like duration of storage or origin of products, and the incomplete database for the calculation of ecological impacts.

With an extensive automation, we could manage to reduce the effort to use the tool substantially; the potentials for simplification seem to be exhausted. The enterprises' database is something that we cannot really influence. The maybe gravest challenge – the incomplete database for ecological impacts – is a major problem that we will not be able to solve and causes the need for further research.

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