

Review of Sustainability Indicators: the area of tension between existing Sustainability Strategies at the Level of the European Union, the National and Regional Level of the Federal Republic of Germany and the Sustainable Development Goals

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Abstract

According to the good governance criteria for sustainable development, a sustainability strategy has to include a target system, as well as a monitoring and an evaluation. The formulation of quantified and terminated objectives in the form of indicators is an important instrument for the binding effect of the strategy on the one hand and for an advanced control and monitoring on the other hand. Indicators are an essential instrument for sustainable analyses and political decision-making. This paper focuses on existing indicators from sustainability strategies, respectively indicators and progress reports, used in the European Union, the Federal Republic of Germany and its federal states, taking the SDG-indicators provided by the UN also into account.

In total 342 indicators were identified in the 16 analyzed sustainability documents and assigned to the 17 SDGs. The wide range of identified indicators shows the variety and the heterogeneous use of indicator systems. The review of the identified indicators demonstrates that a selection of appropriate indicators must be taken, which meets the specifics of a nation or a region, ensures a proper mapping of the SDGs and finally corresponds to the following key points: predictability and data availability, quality criteria, terminated and quantified objectives, SMART criteria, relevance and robustness, interactions, political communicability, vertical integration and coherence. These conditions are discussed using selected indicators and SDGs as an example, focusing the challenges of the sub-national level. The paper draws the area of tension and develops initial recommendations for the improving of the vertical integration of indicator systems within the framework of sustainability strategies at national and subnational levels.

1 Introduction

An important instrument for the implementation of the 2030 Agenda for Sustainable Development are national and sub-national sustainability strategies, which are accompanied by regular and continuous progress reviews (UN GA 2015), (German Development Institute (2015)). A sustainability strategy is a coordinated, iterative, cyclical, participatory and interactive process consisting of thoughts and actions with the aim of integrating the sustainability dimensions (in particular social, ecologic and economic) in a balanced and purposeful manner. (German Development Institute 2015) Sustainability strategies provide a target framework and stipulate principles, procedures and responsibilities on which multi-dimensional negotiation processes are to be based. National and sub-national sustainability strategies are an appropriate instrument for a

well-founded decision-making process beyond legislative periods. (ibid.) Due to their responsibilities, local expertise and their proximity to key stakeholders as well as their extensive experience over many years with the implementation of a sustainability and development policy at the sub-national level, federal states of Germany play an important part in the sub-national implementation and achievement of the Sustainable Development Goals (SDGs). Their contribution is important and necessary to support the national level (Confederation) with the measures to implement the 2030 agenda. (ibid.) Each government, whether at the national or sub-national level, needs its own sustainability strategy adapted to the individual challenges, to the prevailing political, historical, cultural and environmental conditions. A blue-collar approach is, therefore, neither desirable nor worthwhile. (UN DESA 2002) Nevertheless, a wide range of recommendations and guidelines, the so-called good governance criteria, are available which were derived from existing solid and successful sustainability strategies. (OECD 2001), (UN DESA 2002), (ESDN n. y.), (Steurer/Trattnigg 2010), (Quitow 2010), (Bertelsmann Foundation 2013), (Borbonus et al. 2014)

According to good governance criteria, the process of designing a sustainability strategy involves the establishment of goals and objectives, as well as monitoring and evaluation (UN DESA 2002), (ESDN n. y.), (Quitow 2010), (Borbonus et al. 2014). Since the overall picture of a sustainable development is characterized by lack of direct measurability, due to its abstractness, tools (indicators) are required for the measurement (Günther/Schuh 2000).

The implementation of the 17 SDGs and their 169 targets under the use of their 232 indicators (UN DESA 2017), must be integrated into already existing sustainability activities, sustainability strategies and indicator systems of the single countries and its sub-national levels. This may point to a heterogeneous use of indicator systems in the analysed sustainability documents. The implementation is a stress field between existing and established national and sub-national structures for sustainable development on the one hand and the orientation towards the 17 SDGs and 169 targets as well as the performance contribution and its measurement by the 232 indicators on the other hand. The aim of this paper is to make this stress field visible and to support the process for developing an indicator system for Sustainability Strategies by presenting specific conditions for the selection of appropriate indicators which meets the specifics of a nation or a federal state and ensure a proper mapping of the SDGs. These conditions are discussed using selected indicators and SDGs as an example, focussing the challenges of the sub-national level.

2 Background

2.1 Sustainability Strategy of the Federal Republic of Germany and its federal states

The sustainability strategy has a long tradition in Germany. Only one year after the publication of the European Sustainability Strategy in 2001 (Commission of the European Communities 2001), the Federal Republic of Germany published its first sustainability strategy (Federal Government 2002).¹ In 2016, the Federal Government of Germany published a new edition of the German Sustainability Strategy (Federal

¹ Since that date, the Federal Republic of Germany has published a total of three progress reports (Federal Government 2004, 2008, 2012), five indicator reports (Federal Statistical Office 2006, 2008, 2010, 2012, 2014a) and two external peer reviews (German Council for Sustainable Development 2009, 2013).

Government 2016). The revised version of the German Sustainability Strategie is explicitly based on the SDGs (ibid.). By May 2017, a total of 35 publications were published in the framework of the interdisciplinary sustainability reporting in the federal states of Germany (Schostok 2017). This reflects the central importance of the strategies for sustainable development at the level of the federal states. A total of 56 documents on sustainability-related sustainability reports (sustainability strategies, progress-, indicator-, and sustainability reports as well as reviews) were published by the European Union, the Federal Republic of Germany and its federal states during the period from 01.01.2001 to 01.05.2017. (ibid.)

2.2 Sustainability Strategy of North Rhine-Westphalia (NRW)

The federal state of North-Rhine Westphalia (NRW) has a highly energy- and resource-intensive economic structure and is one of the most important regions for the entire Federal Republic of Germany and also within Europe.² The state of NRW has a responsibility for the sustainable development and can make a major contribution to the achievement of the SDGs.

The state government of NRW decided in a cabinet approval from November 2013 to develop a sustainability strategy for the federal state of NRW (MKULNV NRW 2013a).³ In the cabinet approval was noted, that the sustainable strategy should be developed with the participation of all other state ministries, the state government and in exchange with stakeholders from civil society, economy, municipalities and science (ibid.).⁴ In June 2016, the state government of North Rhine-Westphalia adopted the first sustainability strategy for North Rhine-Westphalia (NRW) (State Government NRW 2016a, 2016b), that covers all three dimensions of sustainability (environmental, social, economic). Beside the strategy paper, that is also available in English (MKULNV NRW 2016), a central pillar of the sustainability strategy for NRW is a target and indicator system consisting of roughly 70 indicators with targets for the years 2020, 2030 or 2050 responding to 19 central areas of action in the sustainability strategy (State Government NRW 2016a, 2016b). All indicators are align to the United Nations Sustainable Development Goals (SDGs) of Agenda 2030 (UN 2015). The development of the

² The state of NRW is the most densely populated area (515 inhabitants per km²) in Germany and with about 17.6 million inhabitants (22% of the German population) one of the most important urban areas in Europe (Federal Statistical Office 2014b). The state of NRW is a national and international important economic region: 21.9% (625 billion euro) of German GDP were generated in NRW in 2013, these are 4.6% of European GDP (EU-28) (NRW.INVEST n.y.). A total of 15.9% of Germany's export goods are produced in NRW - this results in an export value of 180.6 billion euros in 2014 (ibid.). With 27.67% of Germany's electricity production (2013) and a share of 100% of the hard coal and 53.8% of the brown coal production (2013), the state of NRW is the most important energy and coal mining region in Germany (IWR n.y.a), (BMWi 2014). However, NRW is also the number one energy source on the consumer side: 31.3% of the German energy market and 23.7% of the German net electricity market are consumed in NRW (2013) (IWR n.y.b, n.y.c). The North Rhine-Westphalian industry accounts for 28% of German net electricity consumption and emits 18.6% of industrial greenhouse gas emissions (GHG) in Germany (IWR n.y.c), (MKULNV NRW 2014). The GHG emissions of the energy industry in NRW account for 36% of the GHG emissions from the energy industry throughout Germany (MKULNV NRW 2014).

³ This decision was based on a coalition agreement 2012-2017 of the federal state of NRW (NRW SPD/Bündnis 90/Die Grünen NRW 2012).

⁴ As a result, several cooperation and participation elements were established within the process of developing the sustainability strategy: an inter-ministerial working group (IMAG Sustainability), annual sustainability conferences (2012 – 2016), two public consultation rounds (2014, 2015) and three accompanying projects: a project on the "Successful Development of Sustainability Strategies" by the Bertelsmann Foundation (n.y), participation projects by the Local Agenda 21 NRW (n.y.) and two accompanying research projects by the Wuppertal Institute for Climate, Environment and Energy (2013, 2016).

sustainability strategy and the indicator report of NRW were scientifically accompanied by the Wuppertal Institute.

2.3 Accompanying Research Projects by the Wuppertal Institute for Climate, Environment and Energy

This paper is based on the partial results of two on-going scientific projects “Sustainability Strategy for North Rhine-Westphalia (NRW) – Conceptual Analyses and Considerations on Designing a Sustainability Strategy NRW from the Science Perspective” (2013-2017) and “Experiences of Implementing Statewide Sustainability Strategies - Case Study: Sustainability Strategy NRW” (2016-2020). (Wuppertal Institute 2013, 2016)⁵ Based on the example of North Rhine-Westphalia, the second research project aims at exploring selected questions that typically arise during the implementation of a state-wide sustainability strategy. One research focus is the compatibility of NRW's sustainability strategy with existing sustainability strategies on UN, EU and national level, as well as to the Sustainable development Goals, with regard to the objectives and indicators used in NRW. (Wuppertal Institute 2016)

The aim of this paper is to present and discuss the lessons-learned made during the development of indicators in the context of the sustainable strategy of NRW. The lessons-learned were transferred into eight criteria and contextualized for sub-national strategies.

3 Materials and Methods

Out of a total of 56 identified sustainability reporting documents, 13 documents were selected. In accordance with the case study selection by Jacob/Kannen/Niestroy (2014), the sustainability documents were selected using the central criteria of data availability and topicality. The criterion of data availability refers to the existence of a sustainability report and a public access to it. Referring to the criterion of topicality, those sustainability documents were selected which were the most recent available documents at the time of the analysis (2015). All federal states which had published a sustainability strategy, a indicator- or progressreport at that time were included as a basis for the investigation. The period covered in the analysis is from 2013 to 2015.⁶

Thirteen sustainability indicators and indicator and progress reports at the EU, national and federal state level are forming the basis of the analysis framework. In addition to the 12 headline indicators contained in the EU Sustainable Development Strategy, all 128 contextual indicators and sub-indicators were considered in the review of this strategy (Eurostat n.y.a). In addition two environmental indicator reports containing specific indicators for the Federal State of NRW and a collection of materials of the official statistical office NRW (IT.NRW) were examined (MKULNV NRW 2013b), (BLAG KliNa 2015), (IT.NRW 2013). Hence, a total of 16 sustainability documents are used in the empirical inventory which are listed in Table 1. These documents provide the framework for analysis, enabling us to build on this experience and to learn from it.

⁵ Both projects are funded by the Ministry for Climate Protection, Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia.

⁶ It should be noted, that an investigation of all sustainability documents published until 2015 made no sense due to duplication and updates. In order to examine the compatibility of the potential indicator system of NRW with other indicator systems, a comparison of the most recent indicator systems is sufficient to address the challenges of the status quo and to derive recommendations for action to the state of NRW.

Government-level	Sources: Sustainability Documents (2012 – 2015)
European Union	Monitoring report of the EU sustainable development strategy 2013 (Eurostat n.y.b, 2013) Europe 2020 strategy (Federal Statistical Office 2013)
Federal Republic of Germany	Progress report on the National Sustainable Development Strategy 2012 (Federal Government 2012) Indicator Report 2014 (Federal Statistical Office 2014a)
Federal States of Germany	
Baden-Württemberg	Indicator Report 2014 (UMBW 2014)
Bavaria	Sustainability Strategy 2013 (STMUV Bayern 2013)
Brandenburg	Sustainability Strategy 2014 (MLUL BB)
Hesse	Progress Report 2014 (Hessian Statistical Office 2014)
Rhineland-Palatinate	Indicator Report 2013 (MWVLW RLP 2013)
Saxony	Sustainability Strategy 2013 (SMUL Sachsen 2013)
Saxony-Anhalt	Indicator Report 2014 (MULE Sachsen-Anhalt 2014)
Schleswig-Holstein	Table of sustainability indicators 2010 (MELUIR SH 2010)
Thuringia	Indicator Report 2012 (Thuringia 2012)
North Rhine-Westphalia	Material collection of the statistics center NRW 2013 (IT.NRW 2013) Environmental Report NRW 2013 (MKULNV NRW 2013b) Environmental sustainability indicators provided by the Joint Working Party of the Federal Government and the Federal States on Climate, Energy, Mobility – Sustainability (BLAG KliNa 2015)

Table 1. Analysis documents containing sustainability indicators at the EU, national and federal state level. Source: own research.

The in-depth analysis of these 16 sustainability documents is based on a three-step approach. In the first step all indicators were sorted by 21 fields of action and cross-cutting issues responding to the cabinet approval of the government of NRW (MKULNV NRW 2013a)⁷ and examined by ten characteristics:

- Indicator name and unit of measurement,
- definition and information about the operationalization of the indicator,
- explanation of method,
- information about the raw data underlying the indicator,
- secondary source (is used by),
- classification by reporting indicator or target indicator or not classified,
- quantified and scheduled target statements
- and interactions to other fields of action and cross-cutting issues.

A differentiated, detailed presentation of the sustainability indicators identified is given in a separate Excel file. (Schostok 2015a)

The second step consisted of a commentary and supplementary loop of key actors and scientist. Following the analysis of the documents, the summary list of indicators was sent to the “TEAM Sustainability”⁸ and to selected field and cross-section-specific experts at the Wuppertal Institute. Both had no amendments, but the consulted experts extended the list of identified indicators by further 74 new indicators to be reviewed. (Schostok 2015a)

In the third step, the indicators identified and analysed in the 16 sustainability documents have been assigned to the SDGs. The aim of this reorganisation and allocation was to

⁷ See Appendix A for the 14 fields of action and 7 cross-cutting issues.

⁸ The reason for the integration of the “TEAM Sustainability” is due to the necessity to ensure that the assessment incorporates with the values and concerns of the stakeholder (Lozano/Huisigh 2011). The “TEAM Sustainability” serves the advisory, discursive accompaniment of the scientific Projects of the Wuppertal Institute addressing the Sustainable Strategy of NRW, and thus indirectly the development and implementation of a sustainability strategy NRW from the stakeholder perspective by means of open, internal discussions. (Wuppertal Institute 2013, 2016)

create a broader verifiability which goes beyond the specifics of the Federal State of NRW and thus is detached from the 21 fields of action and cross-cutting issues responding the point of view of the Government of NRW.⁹ The new structure creates a broad basis for the new and further developing of indicator systems for sustainable development, for both the national and sub-national levels.

Based on the principle of one indicator largely describing a SDG, each indicator is assigned to precisely one SDG. The assignment of an indicator to exactly one SDG is not trivial,¹⁰ because considerable overlapping meant that some indicators could be assigned to several SDGs.¹¹

⁹ Direct allocation of the fields of action and cross-cutting issues was not possible due to the numerous overlaps and interdependencies among fields of action and cross-cutting issues and the SDGs so that the allocation had to take place at the level of the indicators directly.

¹⁰ This fact is confirmed by the UN (UN DESA 2017): In the revised list of global Sustainable Development Goal indicators, nine indicators are repeated, which are assigned to several SDGs respectively SDG-targets. Under double counting the total number of 232 SDG-indicators is extended to 244 SDG-indicators.

¹¹ This can be illustrated using two examples: 1) The indicator “Energy consumption in private households” was assigned to the SDG 7 “Affordable and clean energy”, despite the fact that this indicator could also represent an aspect of sustainable consumption (SDG 12 “Responsible consumption and production”). The above classification was based on the clustering of similar indicators, resulting in all indicators that measure energy consumption being assigned to the SDG 7. This procedure applies to indicators that portray total energy consumption, energy consumption differentiated by sector, and energy consumed by a single sector. 2) The indicator “Transport greenhouse gas emissions by mode” was assigned to the SDG 13 “climate action”, even though this indicator could also represent statements on other SDGs such as SDG 12 and SDG 11 “Sustainable cities and communities”. In addition to the clustering explanation (see above), this indicator was classified on the basis of its implied objective. In this case, the reduction of greenhouse gas emissions contributes to climate protection.

4 Results

A total of 342 indicators were identified in the 16 sustainability documents analysed. Figure 1 shows how many indicators were assigned to each SDG.

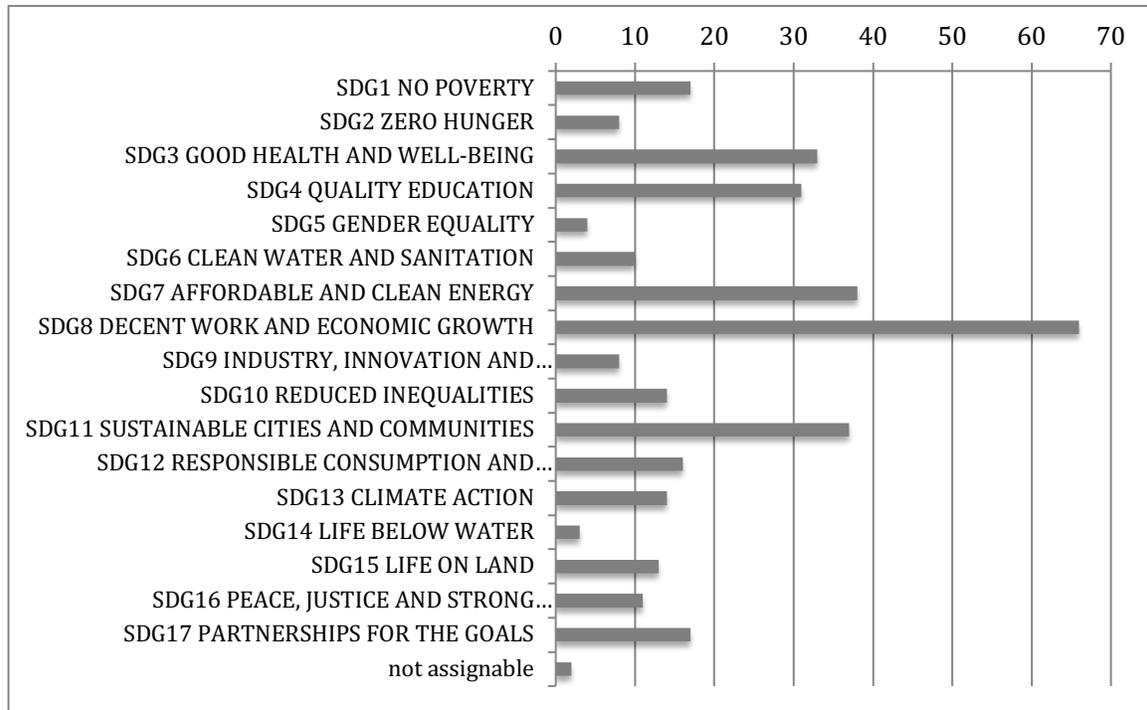


Figure 1. Distribution of indicators according to the SDGs. N=16, n=342.
Source: own research.

It can clearly be seen that a large number of indicators were identified, some of which had different characteristics and units. Those indicators that could not be assigned clearly to the SDG associated to the group “Non-assignable indicators”. All the indicators identified are different, although a small part of the indicators is only operationally differentiated or contains different units of measure. However, these differences are not transparent for the wide range of stakeholders of a sustainability strategy. Moreover, a comparison between sustainability strategies is not obvious. In addition, unambiguous operationalization’s and units of measure can be used to highlight certain aspects or to conceal negative aspects. The wide range of 342 identified indicators shows the variety and heterogeneous use of indicator systems in the analysed sustainability documents. This substantiates a restricted comparability among the indicators and creates a sound basis for further considerations regarding the development of an indicator-system at the same time.

5 Discussion

The analysis of the 16 sustainability documents reveals a wide range of indicators, creating a solid basis on which further consideration can be given to developing an indicator system for national and sub-national sustainability strategies. As has already been shown in the scientific literature, the development of an indicator system is to be based on specific criteria (Ramos 2009), (Dalal–Clayton/Bass 2002), (Günther/Schuh 2000). In the course of designing an indicator system, care must be taken to select

appropriate indicators with regard to the suitable representation of the SDG and its targets. In the process, the indicators – in particular the quantified and scheduled target statements – should not be transferred one-to-one to the national or sub-national level. Instead, appropriate indicators should be selected that account for specific features in the Country or Federal State and also comply with the priorities of eight basic points, which are described in the following sub-chapters. This eight criteria are based on the experiences made during the development of indicators in the context of the sustainable strategy of NRW. In the following, these criteria are discussed and contextualized in the sentence on sub-national sustainability strategies.

5.1 Computability and data availability

Indicators shall be examined with regard to their computability. To achieve this, the consistent application of definitions and data availability are crucial. This is explained in the following example. The EU Sustainable Development Strategy currently maps resource productivity using the indicator “Domestic Material Consumption” (DMC) (Eurostat 2017), which in future is to be developed progressively via the product group-specific “Raw Material Equivalent” (RME) to “Raw Material Consumption” (RMC). Calculations of RME, and hence of RMC or TMC (if the focus is on total material consumption), are based on “Environmentally extended input-output analysis” (EE-IOA). EE-IOA is used to determine total quantities of raw materials and resources connected to goods imported into and exported from an economy in the global context. (Acosta/Schostok 2016)

The basis for this is the detailed information about an economy’s consumption and production characteristics. This information is given in input-output tables, also including the politically relevant direct effects of consumption produced and consumed in the economy under consideration. Detailed input-output tables exist for a broad range of Nations, but there are no such tables at the sub-national levels. Hence it is not possible to calculate these resource indicators for the sub-national levels given the current data situation. First of all, a production system model specific to a Federal State (i.e. a quasi input-output table) would have to be established to enable the calculation and hence compatibility with the resource indicators for the future sought by the EU and the Federal Governments. (Schütz/Acosta 2015)

5.2 Quality criteria

Indicators should comply with the quality criteria of empirical measurements. In accordance with the principle of objectivity, the findings reflected by the indicator should be independent of the persons conducting the investigation. (Häder 2015) The indicator should comply with the principle of reliability, being so reliable that repeated measurements of an object using a measuring instrument produce the same values. In addition, indicators should comply with validity, being valid in that the measuring instrument actually measures what it is supposed to measure. (Schnell/Hill/Esser 2005)

As an example of the quality criterion of validity, mention is made at this point of the indicator “Obesity,” which is assigned to the SDG 3 “Good health and well-being”. Obesity is defined as an increase in body fat above the normal extent. Weight classification is evaluated on the basis of the Body Mass Index (BMI). The BMI is the ratio of weight to height squared (kg/m^2). (DAG 2015) According to the classification of the World Health Organization (WHO), adults with a BMI $\geq 25 \text{ kg/m}^2$ are defined as overweight and as obese if they have a BMI $> 30 \text{ kg/m}^2$. No account is taken of age- and gender-specific differences in the classification. (WHO 2000) Obesity increases the risk of developing cardiovascular diseases and cancer. In addition, the more overweight a person becomes, the greater the risk of mortality. (WHO n.y) Examples of further

consequences from an economic perspective include absence from work due to illness and early retirement due to illness, (ibid.) which is indicative of interaction with the SDGs 8 “Decent work and economic growth”. The indicator “Obesity” is used by the Federal Government and several federal states of Germany, subdivided into the percentage of adults who are obese, and obesity in schoolchildren at the time of being examined when starting school.

In the case of the indicator “Obesity in adults”, there are differences with regard to operationalization. For example, adults are defined differently: Baden-Württemberg (UMBW 2014) and the WHO (2016) define adults as being aged over 20, whereas the Federal Government of Germany (Federal Statistical Office 2014a) and the Federal State of NRW (IT.NRW 2013) define adults as being aged over 18. As an early warning, Rhineland-Palatinate (MWVLW RLP 2013) and Baden-Württemberg (UMBW 2014) even present data for $BMI \geq 25 \text{ kg/m}^2$.

The question needs to be asked whether underweight, classified by the WHO as people with an $BMI < 18.5 \text{ kg/m}^2$, should also be shown in an indicator in addition to obesity (WHO 2000). This is relevant because 8.3% of the adults in the 18 to 20 year group surveyed in the 2013 Microcensus in Germany, for example, stated that they had a BMI of less than 18.5 kg/m^2 . By comparison, only 3.5% of respondents in the same age group stated that they suffered from obesity ($BMI > 30 \text{ kg/m}^2$). (Gesundheitsberichterstattung des Bundes 2015) However, no quantified targets were identified in the sustainability documents.

On the whole, the BMI is known in the public and the media as a dimension for demonstrating underweight and overweight. It must be criticised, however, that the BMI makes no distinction as to whether the body weight is composed primarily of fat or muscle and how that is distributed in the body. (Schneider/Seifarth 2015)¹²

5.3 Scheduled and quantified targets: SMART criteria

Indicators should be linked to scheduled and quantified targets. These targets should be formulated according to SMART criteria.

- “Specific – target a specific area for improvement.
- Measurable – quantify or at least suggest an indicator of progress.
- Assignable – specify who will do it.
- Realistic – state what results can realistically be achieved, given available resources.
- Time-related – specify when the result(s) can be achieved.” (Doran 1981)

In order to translate indicators into quantified and scheduled objectives, ideally not only target statements, chains of arguments, monitoring and evaluation, but also concrete implementing measures are required. A more binding situation can be achieved by coupling the target system to continuous, transparent monitoring and evaluation, and by specifically substantiating the target system in concrete implementing measures. Such a procedure would comply with the good governance criteria for designing a sustainability strategy. (German Development Institute 2015), (ESDN n.y), (Quitow 2010),

¹² The so-called “A Body Shape Index” (ABSI) should be reviewed as an alternative to the BMI . The indicator “A Body Shape Index” considers not only body weight, but also height and waist circumference, i.e. the distribution of fat in the body, and is therefore able to gauge health risk more accurately based on the distribution of body fat. The ABSI is calculated using the formula $\text{waist circumference} / (BMI^{2/3} \cdot \text{height}^{1/2})$. (Schneider/Seifarth 2015) Classification of the ABSI results takes into account both age-specific and gender-specific differences. (ibid.) The example of the indicator “Obesity” illustrates the complexity of the selection, definition and operationalization of an indicator, outlining the key challenges associated with targets and political communicability and opening the horizon for alternative indicators.

(Bertelsmann Foundation 2013) This can be highlighted using the example of climate protection.

In order to protect the global climate, the global temperature rise must be limited to a maximum of 2°C by 2050 (IPCC 2014). However, the 2°C mark is not a safe barrier to protecting the climate on reaching the 2°C target is attributable to considerable climate damage (Arens et al. 2015). With the "Paris Agreement", the 21st Conference of States Parties agreed in December 2015 to limit the temperature rise to a maximum of 2°C and also to intensify the efforts to increase the temperature increase to 1.5°C above the pre-industrial level (UNFCCC 2015). One of the main reasons for global warming is the emission of greenhouse gases, referred to as Kyoto gases (UNFCCC 1998). Greenhouse gas emissions in the EU are to be reduced by 80-95% below the 1990 baseline by 2050 and Germany will make a significant contribution to achieving this target (Federal Government 2010).

The federal State of NRW is the biggest emitter of greenhouse gases in the comparison of the federal states in Germany, responsible for around 32% of Germany's greenhouse gas emissions. (LANUV NRW 2014). Against this background, the state of NRW is pursuing an ambitious climate protection strategy (Müller/Schostok/Treude 2015): By passing its Act on the Promotion of Climate Protection in North Rhine-Westphalia (NRW Climate Protection Act) in 2013 (MIK NRW 2013), the Federal State of NRW has set out to establish climate protection goals as well as to create the legal bases for developing, implementing, monitoring, reporting on and updating climate protection and climate adaptation measures (Section 1 of the NRW Climate Protection Act). The total amount of greenhouse gas emissions in North Rhine-Westphalia shall be reduced by at least 25% by 2020 and by at least 80% by 2050 measured against overall emissions in 1990 (Section 3 of the NRW Climate Protection Act).

Consequently, the Federal State Government of NRW has a scheduled and quantified target system for the indicator "Greenhouse gas emissions", which is compatible with both European and national targets. With its Climate Protection Plan for NRW (MKULNV NRW n.y.), the Federal State Government can also draw on a wide range of proposed measures for implementation. The Climate Protection Plan is a roadmap for the new climate protection policy "made in NRW" and the central instrument for achieving NRW's ambitious climate protection targets. To this end, concrete strategies and individual measures are defined in the Climate Protection Plan.¹³ These strategies have been analysed comprehensively in an impact analysis using important areas of impact and indicators not only for the energy system, but also for key environmental, economic and social aspects. (Prognos 2014) The impact analysis enables policy-makers and actors in the participatory process to make a comprehensive, qualified assessment of the scenarios' impacts and is thus an additional decision-making support, particularly for policy-makers in the Landtag, for assessing scenario variants and the underlying strategies. (Prognos 2014)

This example demonstrates the Federal State of NRW's potential for designing a target and implementation system for the indicator "Greenhouse gas emissions". It can be used as a role model for designing scheduled and quantified target statements for other indicators, regardless of whether a legal or strategic foundation already exists or has yet to be created in the course of developing the sustainability strategy.

¹³ A benchmark for climate protection plans and laws at the level of the federal states is provided by Fishedick et al. (2015). Since 2016 also the Federal Government of Germany has a climate protection plan, including climate protection policy principles and objectives up to the year 2050 (BMBU 2016).

5.4 Relevance and Robustness

The relevance of each indicator should be reviewed because not all indicators are relevant to Country or Federal State. The indicator “Size of fishing fleet” used as a sub-indicator in the EU Sustainable Development Strategy (Eurostat n.y.a, n.y.b), or the indicator “Proportion of fish stocks within biologically sustainable levels” (SDG-indicator 14.4.1) (UN DESA 2017) for example, to map part of the SDG 14 “Life below water”, contributes to the assessment of marine ecosystems and is of no relevance to the sustainability strategy of a landlocked Federal State.

Another guardrail for the development of an indicator system is the robustness of an indicator. An indicator should map a circumstance or a feature quickly, easily and accurately, without being too highly differentiated (see chapter 1). The indicator “Greenhouse gas emissions” is an example of a robust indicator. It is an accurate indicator of the development of climate change, as explained above.

5.5 Interactions

Sustainability reporting and indicator reporting in particular has become holistic and integrative, due to the need for some indicators to address several dimensions of sustainability at the same time (Lozano/Huisinigh 2011), (Perrini/Tencati 2006). In the course of developing sustainability indicators, any interactions between indicators and SDGs and its targets must be identified and addressed. The indicator “Personal bankruptcies,” for example, is used by the Federal State of Baden-Württemberg in the theme “Participation and good life”. The indicator covers all official personal insolvencies per 10,000 inhabitants. Personal insolvency proceedings include consumer insolvencies, proceedings against persons who were previously self-employed, former partners of partnerships and estates. (UMBW 2014) Corporate bankruptcies are also highly significant to the Federal State of NRW in addition to personal insolvencies because NRW has by far the most company insolvencies compared to other German federal states (per 100,000 companies). (Federal Statistical Office n.y.) The indicator “Personal insolvencies” is assigned to the SDG1 “No poverty” because this indicator refers to the financial negative effects that personal insolvency can have. Interactions are discernible, particularly with regard to the SDG 8 “Decent work and economic growth”. Supplemented by company insolvencies, this indicator could also be assigned to the SDG 8 “Decent work and economic growth”. The economic significance of insolvencies cannot be assessed solely on the basis of the number of insolvencies, but also on the basis of the bad debts associated with them and the number of staff made redundant. (Angele 2008)

5.6 Political communicability

Indicators should be politically communicable not only internally (State Government and state administration staff) but also to the outside world (society, politics, business, science). Examples of formal possibilities to implement good political communication include:

- selection of an appropriate number of indicators (as a rule, between 30 and 75) (Diefenbacher et al. 2011),
- selection of an appropriate level of aggregation,
- pooling in an index,
- differentiation between headline indicators and sub-indicators, as well as contextual indicators, where applicable,
- differentiation and hierarchy of indicators by sector (e.g. total greenhouse gas emissions and transport greenhouse gas emissions),

- differentiation between reporting and target indicators,
- an age-specific and gender-specific differentiation of indicators, which may ultimately prove useful in communicating with and reaching the target group.

Reference can be made once again to the indicator “Obesity” as an example of the political communication of sustainability indicators in connection with implementing measures. Even if the percentage of adults with obesity is to be reduced, political statements should be worded positively. Measures and actions should promote health, and refer to a healthy and balanced diet as well as adequate exercise.

5.7 Vertical integration

According to good governance criteria for designing sustainable strategies, there must be a vertical integration of indicators and targets. The federal states play a particularly important role in this case because, on the one hand, their sustainability strategy should be compatible with those at the national, supranational (e.g. EU) and global level (esp. SDGs). Furthermore, it must be investigated whether the individual target values of the federal states are compatible with the higher political levels of the multilayer system. Are there any laws, standards or commitments that individual federal states have to follow? On the other hand, the indicator and target system at the state level also has the potential to tie in with municipalities and districts. In order to ensure that municipalities and districts can be guided by the State Government’s indicator system and can translate the defined targets to their regional peculiarities and challenges, the extent to which compatibility exists, particularly with regard to the aspects of relevance, data availability and computability, must be investigated at an early stage.

5.8 Coherence

Finally, the whole indicator system should comply with the principle of coherence, which states that all indicators should serve the purpose of sustainability and that individual quantified and scheduled targets should head in the same direction, hand in hand. With regard to vertical coherence, an institutionalized coordination between the national, state and local authorities is essential. (Jakob/Kannen/Niestroy 2014), (German Development Institute 2015) With regard to horizontal integration, an intra- and inter-ministerial coordination is recommended. (German Development Institute 2015) We also recommend that for the development of new sustainability strategies at the sub-national level existing sustainability projects and programmes undertaken by the federal states should be taken into account. The study conducted by the Wuppertal Institute, which has identified 311 key sustainability activities in NRW with the involvement of key stakeholders in the country and in line with horizontal integration, point to a possible approach to an inventory of sustainability activities (Müller/Schostok/Treude 2015).

6 Conclusions and Outlook

This report represents an analysis of 16 sustainability documents at the EU, national and federal state level. In total 342 indicators were identified in the 16 analysed sustainability documents and examined in-depth. The wide range of identified indicators shows the variety and heterogeneous use of indicator systems. This substantiates a restricted comparability among the indicators. The review of the identified indicators shows that a selection of appropriate indicators must be taken, which meets the specifics of a nation or a region, ensure a proper mapping of the SDGs and correspond to the following key points: predictability and data availability, quality criteria, terminated and quantified

objectives, SMART criteria, relevance and robustness, interactions, political communicability, vertical Integration and coherence.

But after all, an indicator is not necessarily a good indicator to pursue a SDG-target simply because it is used in other sustainability strategies or is listed as a SDG-indicator. To support the process for developing an indicator system for Sustainability Strategies, additional indicator systems, innovative and alternative indicator(systems) as well as qualitative indicators has to be taken into consideration.

In addition, it can be stated that qualitative indicators are also suitable for sustainability reporting. As a good example the indicator report of Baden-Württemberg must be mentioned. The Federal State of Baden-Württemberg has added subjective indicators that reflect people's attitudes based on representative surveys on the basis of the Socio-Economic Panel (SOEP). By taking this approach, Baden-Württemberg wants to avoid a reduction to measurable and countable aspects of sustainable development. Many factors are not available as data – quality of life, for example, is an important factor in sustainable development, and yet it is still impossible to capture it in figures and data. (UMBW 2014) In spite of critical objections with regard to the concept and methods, there is broad consensus that subjective indicators are an important part of any global indicator system (Grunwald/Kofmüller 2011).

The analysis shows, that in the analyzed documents no innovative and alternative indicator(systems) were used. However sustainability indicators and sustainability indices on overall social well-being and quality of life, and innovative and alternative forms of measuring poverty and wealth are particularly important and should be implemented in national and sub-national sustainability strategies. Examples are made in Appendix B.

The wide range of identified indicators substantiates a limited vertical integration among the multilayer government system by a restricted comparability among the indicators and creates a sound basis for further considerations regarding the development of an indicator-system at the same time. In a comparison to previous indicator reviews, it is shown that there is a clear distribution and focus in the examined sustainability strategies, which is not nearly coincident with the main emphasis and the number of indicators of the respective SDG. Due to this, central differences and similarities of the identified indicators are discussed in correspondence to the 17 SDGs. The review of the identified indicators demonstrates that a selection of appropriate indicators must be taken, which meets the specifics of a nation or a region on the one hand, but still obtain a balance in the consideration and purposeful implementation between the SDGs on the other hand.

Appendix A

Overview of fields of action (MKULNV NRW 2013a)

- Climate protection
- Energy transition
- Sustainable economy
- Protection of natural resources: biodiversity, forests, water, land/soil, sustainable land management, air, environment, health
- Demographics
- Fair work
- Integration and interculturality
- Social cohesion and participation
- Sustainable financial policy
- Sustainable development of urban areas and neighbourhoods
- Local mobility
- Sustainable consumption and lifestyles
- Education for sustainable development
- One World policy

Overview of cross-cutting issues (MKULNV NRW 2013a)

- Accessibility and inclusion
- Education, science, research and innovation
- Civic engagement and participation
- International dimension
- Sustainable municipalities (Local Agenda 21)
- Gender equality (gender mainstreaming)
- Impacts on rural areas

Appendix B

Examples of sustainability indicators and sustainability indices on overall social well-being and quality of life, and innovative and alternative forms of measuring poverty and wealth:

- Canadian Index of Wellbeing (University of Waterloo 2016);
- Sustainable City Index (ARCADIS 2015);
- Sustainable Society Index (Sustainable Society Foundation 2014);
- Social Progress Index (Porter/Stern/Green 2016);
- W3 Indicators (Deutscher Bundestag 2013);
- Happy Planet Index (HPI) (Nef 2012);
- Better Life Index (BLI) (OECD 2011);
- Wohlstandsquintett (Wahl/Schulte/Butzmann 2011);
- Inequality-adjusted Human Development Index (IHDI) (UNDP 2010);
- Multidimensional Poverty Index (MPI) (Alkire/Emma 2010), (UNDP 2010);
- National Welfare Index (NWI) (Diefenbacher/Zieschank 2009, 2010);
- National Accounts of well-being (Nef 2009);
- Index of Social Health (ISH) (Institute of Innovation in Social Policy 2008);
- Gross National Happiness Index (Centre for Bhutan Studies 2010);
- KfW Sustainability Indicator (KfW 2006);
- Australian Unity Wellbeing Index (Australian Unity 2001);
- Index of Economic Well-Being (IEWB) (Osberg/Sharpe 2001);
- City Development Index (CDI) (UN Habitat 2001, 2002);
- Weighted Index of Social Progress (WISP) (Estes 1997);
- Happy Life Years (HLY) / Happy Life Expectancy (HLE) (Veenhoven 1996);
- Genuine Progress Indicator (GPI) (Cobb/Halstead/Rowe 1995), (Cobb/Goodman/Wackemagel 1999);
- Human Development Index (HDI) (UNDP 1990);
- Index of Sustainable Economic Welfare (ISEW) (Daly/Cobb 1989).

An overview of (other) national and international initiatives for alternative measures of wellbeing is given in reports such as “Gut leben Global. Neue Ansätze der Wohlstandsmessung und SDGs in Deutschland” [Living well globally. New approaches to measuring well-being and SDGs in Germany] published by the Global Policy Forum Europe and terre des hommes. (Martens/Obenland 2015)

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