Moving the world into a safe space – the GAPFRAME methodology

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Abstract

In September 2015, the United Nations General Assembly adopted a set of Sustainable Development Goals (SDGs) to address global challenges over the next 15 years. To advance implementation of the SDGs, a new framework − called GAPFRAME − has been developed. The framework highlights the gap between the current state of the world and a desired future state, identifying priority issues that need to be urgently solved on a national, regional, and global level to make progress towards the SDGs and ultimately reach a "safe space". The GAPFRAME focuses attention on addressing identified priority issues, holding each country or region accountable for the successful implementation of the global sustainability targets within their area of responsibility. The framework is particularly suited for business since it can be used as a strategic business tool to identify long-term business opportunities.

In this publication, we explain in detail the GAPFRAME methodology. We cover the different steps in the design of the framework, in scaling, normalization, weighting, and aggregating the information collected to create the GAPFRAME Index V1 version. The original GAPFRAME publication can be found under Muff, Kapalka, Dyllick (2017). The www.gapframe.org website provides free access to our data collected for 196 countries and 22 regions across the world. The website was launched with the intention to provide decision-makers with aggregated information on local and regional situations, to assist them in their decision-making process and to enhance the multi-stakeholder collaboration across the globe.

Key words: GAPFRAME; Index; Sustainable Development Goals (SDG); Business Sustainability; Methodology; Indicators; National Priority Issues; Long-term Business Opportunities

1. Introduction

There are a large number of indices and frameworks to assess progress in sustainable development. Most sustainability indices have been developed to measure concerns emerging from environmental, economic or social problems. Some examples include: *Environmental Performance Index*, formulated to measure progress towards environmental sustainability, *Sustainable Society Index,* that monitors sustainability and quality of life aspects, *Legatum Prosperity Index*, developed to demonstrate the relationship between economic activities and their impact on quality of life, *Composite Sustainable Development Index*, created to track information on economic, environmental, and social performance of a company with real-time information, as well as many others (EPI, 2014; SSI, 2014; LPI, 2016; Krajnc D. and Glavic P., 2005). They perform many important functions such as collection of data reflecting the current global situation, analysis of trends, monitoring of overall progress, and evaluation of countries' performance towards sustainable development. They also provide an early warning to prevent economic, social and environmental setbacks (United Nations, 2007) and provide decision-makers with aggregated information on the global and/or local situation to assist them in their decision-making process.

Despite of the are various international efforts on measuring sustainability, only few of them have an integral approach taking into account environmental, economic and social aspects. In most cases the focus is on one of the three aspects. Although, it could be argued that they could serve supplementary to each other, sustainability is more than an aggregation of the important issues, it is also about their interlinkages and the dynamics in the system as a whole. This point will be missing if tried to use them supplementary and it is one of the most difficult parts to capture and reflect in measurements (Rajesh Kumar Singh et al., 2012).

It also appears that indices are being developed mainly to identify, measure and communicate the underlying issues whereas very little attention is paid to the identification of clear and unbiased suggestions on how to overcome the recognised problems. Such suggestions would be particularly valuable when trying to define priority issues that need to be addressed at a local, national and regional level to embrace global sustainability targets.

In an attempt to address the aforesaid shortcomings, we took the challenge to create a new framework, called GAPFRAME, using an integral approach that includes four sustainability dimensions: environment (we call it planet), society, economy and governance (Muff et al., 2017). The framework originates from the Sustainable Development Goals (SDGs), accepted in September 2015 by the United Nations General Assembly to address global challenges over the next 15 years (United Nations, 2016). In the GAPFRAME, we translate the 17 SDGs into nationally relevant issues and indicators, showing where a country (or a region) is today as compared to where it should be in the future. In other words, the framework highlights the gap between the current state of the world and a desired future state, identifying priority issues that need to be urgently solved on a national, regional, and global level to make progress towards the global "Agenda 2030" and ultimately reach a "safe space".

To the best of our knowledge, an attempt to compare the current state of the world to its ideal future state and creating an index that measures the gap between these two states has not been made yet. Instead of comparing countries among themselves (i.e. provide a traditional performance ranking for countries), we seek to point out the weakest issues of each individual country, encouraging various stakeholders to address these sore spots and improve the local situation while simultaneously contributing to the global welfare. In particular, we aim to encourage business to transform the identified issues into business opportunities by following the *Business Sustainability Typology 3.0* approach (Dyllick and Muff, 2016). This approach implies an *outside-in* perspective where a company addresses big sustainability challenges and applies its resources, competencies and innovation power to help resolve them.

We acknowledge that the GAPFRAME approach is very demanding, implying the definition and approximation of an "ideal state" of the world which is very challenging on many grounds. They include questions of indicators selection, data availability, manipulation and aggregation, but also normative questions related to defining ideal states for the different indicators. In particular with regard to these normative challenges, we want to provide as much transparency as possible to enable the reader to understand what we did. However, we realize, that there always will remain a degree of subjectivity.

Between October 2015 and December 2016, we co-created the first version (V1) of the GAPFRAME Index in a multi-step consultation process. The V1 version is a first attempt to assess the distance between where we stand today and what needs to be done (country by country) so that all of us can live well on the one planet we have. The true viability of the GAPFRAME Index will prove itself with an expansion of users, who are invited to join expert panels that will review this first version of the framework in 2018 and thereafter.

In this publication, we present information related to the GAPFRAME methodology. We cover the different steps in the design of the framework, in scaling, normalization, weighting, and aggregation methodology employed to create the GAPFRAME Index V1 version. This substantiates our previous article on the GAPFRAME concept published in *The International Journal of Management Education* (Muff et al., 2017) and the www.gapframe.org website that provides free access to our data collected for 196 countries and 22 regions across the world.

2. Overview of the GAPFRAME approach

The Agenda 2030 demands the implementation of the Sustainable Development Goals by all of us − from governments and business to NGOs and individuals – and relies on a robust follow-up and review mechanism to monitor progress and to ensure accountability of all nations (United Nations, 2016).

To advance implementation of the SDGs and to monitor sustainable development, we developed the GAPFRAME in consultation with a panel of experts (see *Acknowledgments*). Its focus is on addressing priority issues at a national level, holding each country equally accountable for the successful implementation of the globally agreed sustainability targets.

The GAPFRAME development process included 6 steps, as summarized in Figure 1.

In the ***first step*** we reorganized the 17 Sustainable Development Goals into 24 GAPFRAME issues and four sustainability dimensions: planet, economy, society, and governance following Rockström's suggestion (Rockström and Sukhdev, 2017).

In the **second step** we selected 68 publicly available indicators to substantiate the underlying issues and to collect respective data for 196 countries and 22 regions in the world. The selected indicators serve as best currently available proxies to measure the state of the issues.

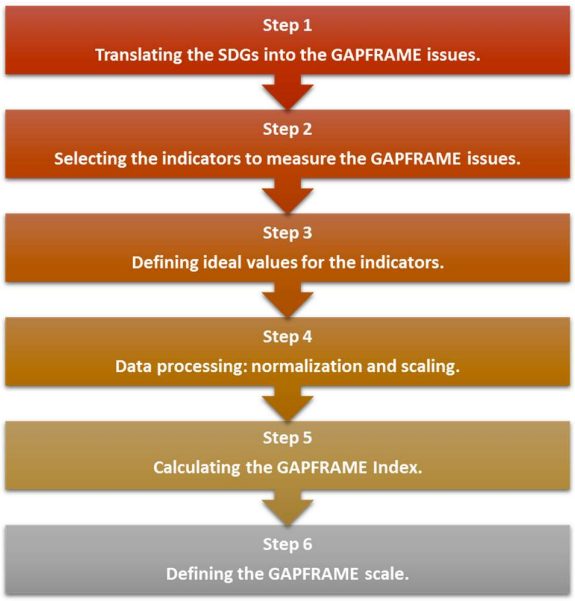

Figure 1. Steps in developing the GAPFRAME.

In the **third step** we tackled the issues to define an "ideal" state of the world and ideal target values for each indicator. We are well aware that this step is the most critical and debatable element of the present framework.

In the **fourth step** we looked at data harmonization and processing. The indicators coming from various sources were normalized and scaled using a 0−10 point scale, with 0 being the worst case (a threat) and 10 being the best case (an ideal state). In this operation, the actual values were compared to their ideal values, relating the current state of the world to its ideal future state.

In the **fifth step** the normalized and scaled indicators were aggregated to calculate the GAPFRAME Index based on the arithmetic mean, thereby giving equal weights to all indicators within an issue, and to all issues within a dimension. In order to construct the GAPFRAME Index score – for a country, region, or the world – we used its weakest dimension, not the average of all 4 dimensions. This was done to follow an approach of strong sustainability, which ensures that one dimension is not improved at the cost of another dimension. As a result, the GAPFRAME score shows how far a given country or region is still away from an ideal state, indicating the priority issues that need to be solved to reach the desired future state.

In the final **sixth step** we specified a five-level scale and we defined a "safe space" as a desired future state, being inspired by the idea of a "safe operating space" developed by Raworth (2012). We place the "safe space" (GAPFRAME score between 7.5 and 8.8) at roughly 80% of the ideal state (the maximum) and we consider it as "good enough" of what future state should be attained. Hence, on the GAPFRAME scale, the goal for any country, region and the world is to move as quickly as possible from the current state to the safe space and above (GAPFRAME Score > 7.5).

These six steps (Fig. 1) present a snapshot of the GAPFRAME V1 development process. They are discussed in detail in the subsequent sections. It is worthwhile to mention that the GAPFRAME development process is still ongoing and the limitations of the GAPFRAME V1 version (see *section 9*) are being progressively addressed in order to increase the robustness of the GAPFRAME Index (see also *Future Developments – section 10*).

3. Translating the SDGs into the GAPFRAME issues (Step 1)

The first step of the GAPFRAME development process was translating the Sustainable Development Goals into the GAPFRAME framework. The 17 SDGs were reorganized into 24 issues of relevance to all nations and business which were structured according to four sustainability dimensions: planet, society, economy, and governance (see Figure 2).

Figure 2. Translating the 17 Sustainable Development Goals (SDGs) into the GAPFRAME issues.

The reorganization of the SDGs into the GAPFRAME dimensions was inspired by the Rockström "wedding cake" concept (Rockström and Sukhdev, 2017) which implies that economy and society are seen as embedded parts of the biosphere. The Rockström model represents a way of viewing the ecological, social, and economic aspects of the Sustainable Development Goals, where the economy serves society so that it evolves within the safe operating space of the planet.

Following the Rockström concept, we applied a hierarchical classification of the 4 dimensions (see Fig. 2), placing the planet at the bottom of the "wedding cake" in order to allow the environment to guide sustainable development. The planet dimension is followed by society, economy and governance, which operate and evolve within the limits of the planet. Within such an approach, the issues in the GAPFRAME are numbered from the bottom of the "cake", starting with the *Biodiversity* issue in the planet dimension and finishing with the *Transparency* issue in the governance dimension (see Fig. 2).

We reinforced and completed the GAPFRAME framework by adding issues that are underrepresented in the Agenda 2030 compared to similarly ambitious and holistic frameworks, in particular Agenda 21 (1992) and the Swiss Cercle Indicateurs (2015). As a result, we added the *Business Integrity*, *Public Finance*, and *Transparency* issues in the governance dimension, whereas the economy, society and environment dimensions were completed with the *Resource Use*, *Social Integration*, and *Clean Air* issues, respectively. Finally, SDG 12 in the economy dimension, *Sustainable Consumption and Production*, was split into two separate issues, given the relevance and impact of each, particularly for business.

Ultimately, we organized the GAPFRAME issues within the four sustainability dimensions as follows:

The **Planet dimension** covers issues related to protection of biodiversity (*Biodiversity*), preservation of land and forests (*Land & Forests*), reduction of carbon footprint (*Carbon Quotient*), conservation of marine environment and its resources (*Oceans*), enhancement of ambient air quality (*Clean Air*), preservation of water resources (*Water*), use of renewable energy (*Clean Energy*) and responsible management of wastes (*Waste treatment*). The planet dimension does not include *climate change* as a separate element for the reason that it is an overarching, inter and trans-dimensional issue.

The **Society dimension** includes social issues related to the standard of life (*Living Conditions*), general well-being (*Quality of Life*), health related aspects (*Health*), access to education and its relevance (*Education*), trends in gender and income equality (*Equal Opportunity*) as well as deeper societal trends like tolerance towards homosexuals and minorities (*Social Integration*). As with *climate change* in the planet dimension, the society dimension does not distinguish *human rights* as a separate issue, due to its inter and trans-dimensional nature.

The **Economy dimension** goes beyond a country's Gross Domestic Product (which is a measure of economic activity and not economic well-being) in order to provide a business-focused perspective that helps to identify long-term business opportunities. Consequently, the economy dimension measures global issues related to employment and job security (*Employment*), responsible use of natural resources (*Resource Use*), sustainable production and consumption (*Sustainable Production, Sustainable Consumption*), and the degree of innovation in developing new solutions (*Innovation*).

The **Governance dimension** is only partially covered in the SDGs although it will be of crucial importance to get this dimension right in order to deal effectively with the complex sustainability issues. In the GAPFRAME this dimension includes issues related to the financial situation of the public sector (*Public Finance*), the adequacy of the general infrastructure and public sector (*Structural Resilience*), political and legal rights as well as civil liberties (*Peace & Cooperation*), responsible and ethical business practices (*Business Integrity*) as well as transparency in managing public resources (*Transparency*).

4. Selecting the indicators to measure the GAPFRAME issues (Step 2)

The GAPFRAME issues were substantiated with a set of meticulously selected indicators. Figure 3 presents an overview of the GAPFRAME structure, listing 68 indicators to measure the 24 GAPFRAME issues. The selection criteria for the indicators and their sources are discussed below.

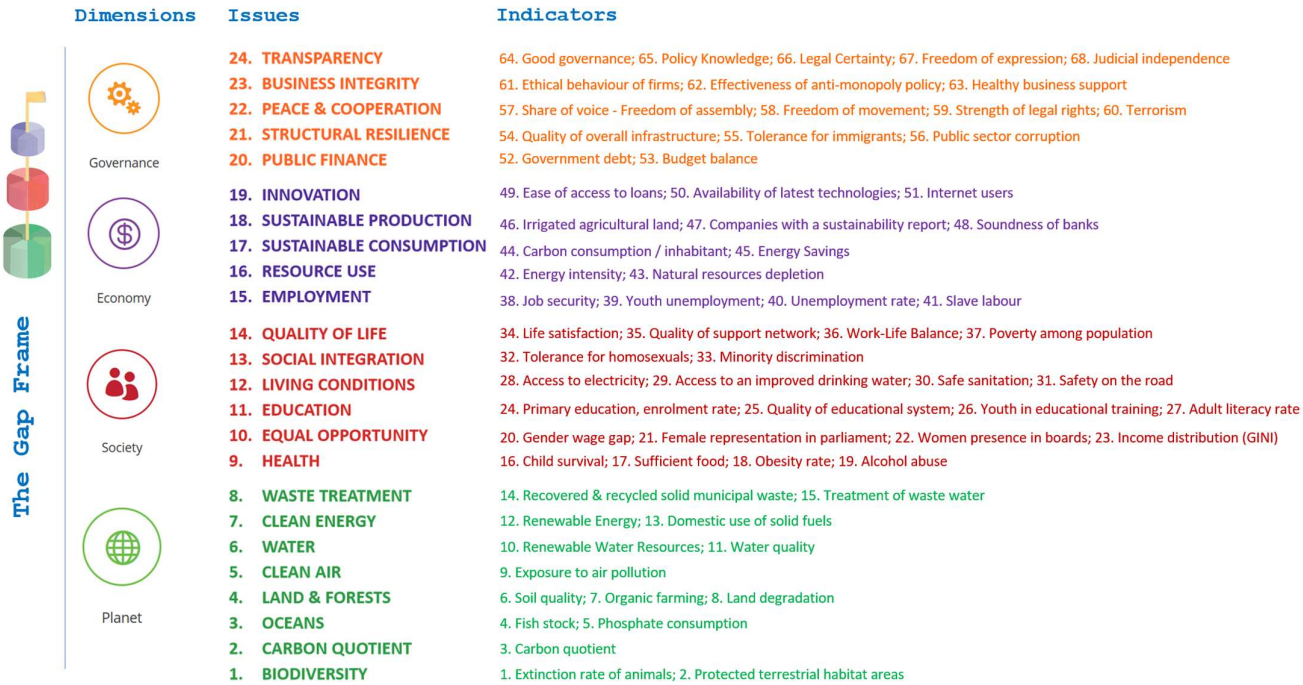

Figure 3. The GAPFRAME dimensions, issues, and indicators.

4.1. Indicator selection criteria

For each issue, we defined a number of indicators that had to represent the issue in a valid way. Here, data availability and comparability was quite a challenge.

The final choice of indicators was governed by the following criteria and considerations:

- **An indicator data source had to be reputable and known for rigorous data collection**. The aim was to collect data from trustworthy sources which are updated on a regular basis.
- **Indicator values needed to be publicly available** (open source data) to allow for independent consultation and verification at any time.
- **The collected data had to be recent**. We collected the latest available data although this meant using data as far back as 2008, in some cases. The aim was to create the most recent index possible while not excluding indicators that collected information on a less frequent basis.
- **An indicator had to be a relevant proxy for an issue**. When selecting the indicators, we involved experts from various fields in a multi-consultation process.
- **The geographical coverage of available data had to be very wide**. Ideally, each indicator data had to be available for most if not all countries considered. In certain cases, we also accepted an indicator with a smaller regional coverage (e.g., data for OECD countries) but are planning to replace them in the next revision of the framework.
- **An indicator had to allow setting an ideal value**. Defining an ideal value for each indictor is a crucial element of the GAPFRAME concept. Many initially considered indicators were dropped

during the consultation process, due to difficulties in setting the ideal values (*example*: there is no ideal value for the number of species by country).

- If necessary, a **new indicator** had to be **defined by ourselves** to substantiate a specific issue. They had to be developed in consultation with experts in the field and rely on publicly available data, however.

4.2. Selected indicators

Following the rules specified above, we ultimately selected 68 indicators to substantiate the GAPFRAME V1 version, averaging 2.8 indicators per issue. Since the indicators are used both to measure a state of an issue and to illustrate different aspects of the issue, we did not identify the statistically most relevant indicator per issue, but used as many indicators as available and needed to illustrate the issue as comprehensively as possible.

The selected indicators are considered as best currently available proxies for the GAPFRAME issues. It is important to emphasize that the indicators are proxies for the symptoms of the problems linked to the GAPFRAME issues. Solving an issue will require to go deeper and address the underlying causes and drivers of the issue.

Ultimately, we constructed the issues of the GAPFRAME as follows (see Tables 1-4 for detailed definitions of the different indicators):

The **Biodiversity issue** (1) is measured as an average of two indicators: *extinction rate of animal species* and *protected terrestrial habitat areas (*EPI, 2014). To the best of our knowledge, there is no publicly available indicator that measures the extinction rate of species per country. Therefore, we defined this indicator ourselves, based on the IUCN Red List data (IUCN, 2016a and 2016b); see details in *section 4.4.1*.

The **Carbon Quotient issue** (2) reflects the carbon footprint represented as a fraction of remaining global biocapacity. We defined this indicator ourselves, based on the National Footprint Accounts data for ecological footprint and biocapacity (Global Footprint Network, 2016); see details in *section 4.4.2*.

The **Oceans issue** (3) is calculated as an average of two publicly available indicators: *fish stocks* (EPI, 2014) and *phosphate consumption* (UNEP, 2010). In the future, we would like to include two more aspects in the *Oceans* issue, *ocean acidification* and *plastic consumption*, if and when the related indicators are published on a global level.

The **Land & Forests issue** (4) is represented by three publicly available indicators: *soil quality* (EPI, 2014), *organic farming* (SSI, 2014), and *land degradation* (UNEP, 2010).

The **Clean Air issue** (5) is based solely on the *exposure to air pollution* (EPI, 2014). We admit that having only one indicator for the *Clean Air* issue is not sufficient to reflect the air pollution problem. We will address this limitation in the next revision of the framework.

The **Water issue** (6) is measured averaging two publicly available indicators: *renewable water resources* (SSI, 2014) and *water quality* (OECD, 2015). Unfortunately, the second indicator is currently available only for OECD countries.

The **Clean Energy issue** (7) is calculated as an average of the *renewable energy* consumption (SSI, 2014) and the *domestic use of solid fuels* (UNEP, 2010).

The **Waste Treatment issue** (8) is calculated as an average of two indicators: *recovered & recycled solid municipal waste* (World Bank, 2012) and *treatment of waste water* (EPI, 2014). The first indicator is currently provided only for 47 countries.

The **Health issue** (9) is calculated as an average of four indicators: *child survival* (EPI, 2014), *sufficient food* (SSI, 2014), *obesity rate* (SPI, 2015), and *alcohol abuse* (WHO, 2010).

The **Equal Opportunity issue** (10) is calculated as an average of four indicators: *gender wage gap* (OECD, 2010-2013), *female representation in parliament* (OECD, 2010-2013), *women presence in boards* (OECD, 2010-2013), and *income distribution* (World Bank, 2010-2015). The first three indicators are only available mostly for OECD countries.

The **Education issue** (11) is calculated by averaging four indicators: *primary education enrolment rate* (WEF GCI, 2005-2014), *quality of the educational system* (WEF GCI, 2005-2014), *youth in educational training* (OECD, 2013), and *adult literacy rate* (World Bank, 2010-2015). *Youth in educational training* has a small geographical coverage (i.e., data available mainly for OECD countries) and needs to be replaced in the next revision of the framework. In addition, we would also like to measure two adjacent aspects: *life-long learning* and *relevance of education*, to broaden the perspective of the *Education* issue.

The **Living Conditions issue** (12) is represented by four indicators: *access to electricity* (EPI, 2014), *access to improved drinking water* (EPI, 2014), *safe sanitation* (SSI, 2014), and *road safety* (SPI, 2015).

The **Social Integration issue** (13) is calculated as an average of two indicators: *tolerance for homosexuals* (SPI, 2015) and *minority discrimination* (SPI, 2015).

The **Quality of Life issue** (14) is based on an average of four indicators: *life satisfaction* (OECD, 2015), *quality of support network* (OECD, 2015), *work-life balance* (OECD, 2015), and *poverty among population* (World Bank, 2010-2015). The first three indicators are only mostly available for OECD countries. Ideally, in the *Quality of Life* issue, we would also like to measure the *child well-being* aspect, if related data is published on a global level.

The **Employment issue** (15) is calculated as an average of four indicators: *job security* (OECD, 2015), *youth unemployment* (World Bank, 2010-2015), *unemployment rate* (SSI, 2014), and *slave labor* (The Global Slavery Index, 2016). The *job security* indicator is only available for OECD countries.

The **Resource Use issue** (16) is calculated as an average of two indicators: *energy intensity* (World Bank, 2010-2015) and *natural resources depletion* (World Bank, 2010-2015).

The **Sustainable Consumption issue** (17) is based on two indicators: *carbon consumption* (Peters, 2011) and *energy savings* (SSI, 2014). In the future, we plan to include also *individual meat consumption*.

The **Sustainable Production issue** (18) is calculated as an average of three indicators: *irrigated agricultural land* (World Bank, 2010-2015), *companies with a sustainability report* (KPMG, 2015), and *soundness of banks* (WEF GCI, 2005-2014). A drawback to the use of the two first indicators is their limited data coverage (available data for 61 and 45 countries, respectively). Ideally, we would also like to include *fossil fuel subsidies* and *true cost considerations* when looking at the *Sustainable Production* issue.

The **Innovation issue** (19) is calculated as an average of three indicators: *ease of access to loans* (WEF GCI, 2005-2014), *availability of latest technologies* (WEF GCI, 2005-2014), and the number of *internet users* (SPI, 2015).

The **Public Finance issue** (20) is calculated as an average of two indicators: *government debt* (SSI, 2014) and *budget balance* (WEF GCI, 2005-2014).

The **Structural Resilience issue** (21) is calculated as an average of three indicators: *quality of overall infrastructure* (WEF GCI, 2005-2014), *tolerance for immigrants* (SPI, 2015), and *public sector corruption* (SPI, 2015). If possible, in the next framework revision round we would like to include two more indicators, covering *speculation* and *cyber-attacks*.

The **Peace & Cooperation issue** (22) is calculated as an average of four indicators: *share of voice – freedom of assembly* (SPI, 2015), *freedom of movement* (SPI, 2015), *strength of legal rights* (World Bank, 2010-2015), and *terrorism* (GTI, 2015). We would also like to use indicators that measure *interstate conflicts* and *migration*.

The **Business Integrity issue** (23) is calculated as an average of three indicators: e*thical behavior of firms* (WEF GCI, 2005-2014), *effectiveness of anti-monopoly policy* (WEF GCI, 2005-2014), and *healthy business support* (WEF GCI, 2005-2014). Within this issue, we would like to include *government incentives for sustainable and just business practices* for which there are no global indicators available yet.

The **Transparency issue** (24) is calculated as an average of five indicators: *good governance* (SSI, 2014), *policy knowledge* (SGI, 2016), *legal certainty* (SGI, 2016), *freedom of expression* (SPI, 2015), and *judicial independence* (WEF GCI, 2005-2014). Two considered indicators, *policy knowledge* and *legal certainty* have only a very small geographical coverage (41 countries) and must be replaced in the next revision of the framework.

	ISSUE	INDICATOR		
		NAME	DESCRITPION	DATA SOURCE
PLANET	**1. Biodiversity**	1. Extinction rate of animal species	Extinction rate of animal species calculated as a number of extinctions per million species-years (E/MSY)	Calculation based on IUCN Red List
		2. Protected terrestrial habitat areas	Protection of globally critical terrestrial biomes, as % of their globally proportional abundance.	Environmental Performance Index (EPI)
	2. Carbon quotient	3. Carbon quotient	Carbon quotient (in global hectares per person) is a carbon footprint represented as a fraction of remaining (available) global biocapacity	Calculation based on Global Footprint Network - NFA 2016 ed.
	3. Oceans	4. Fish stock	Fish Stocks (FSOC) - Fraction (in %) of overexploited fish stocks & collapsed by economic zone	Environmental Performance Index (EPI)
		5. Phosphate consumption / cultivated land	Phosphate total nutrients consumption (prod + imp - exp) in tons divided by cultivated land (km2)	UNEP
	4. Land & forests	6. Soil quality	Use of Persistent Organic Pollutants (POPs) - Pesticide Regulation	Environmental Performance Index (EPI)
		7. Organic farming	Organic farming as % of total agricultural area	Sustainable Society Foundation
		8. Land degradation (desertification)	Areas with a potential hazard of desertification (drylands) as % of total area	UNEP
	5. Clean air	9. Exposure to air pollution	Population (in %) exposed to tiny particulate material (PM 2.5 µg/m3). Indicator code PM25	Environmental Performance Index (EPI)
	6. Water	10. Renewable water resources	Renewable water resources as % of annual water withdrawals	Sustainable Society Foundation
		11. Water quality	People (in %) reporting being satisfied with the quality of local water	OECD Better Life Index
	7. Clean energy	12. Renewable Energy	Consumption of renewable energy as % of total energy	Sustainable Society Foundation
		13. Domestic use of solid fuels	Population (in %) using solid fuels	UNEP
	8. Waste treatment	14. Recovered & recycled solid municipal waste	The sum of compost and recycled municipal solid waste as % of total waste	Worldbank report - What a waste (2012)
		15. Treatment of waste water	Treated waste water (in %). Indicator code WASTECXN	Environmental Performance Index (EPI)

Table 1. The GAPFRAME indicators and data sources: ***Planet Dimension****.*

	ISSUE	INDICATOR		
		NAME	DESCRITPION	DATA SOURCE
SOCIETY	9. Health	16. Child survival	Probability of child surviving 5th birthday. Indicator code CHMORT	Environmental Performance Index (EPI)
		17. Sufficient food	Undernourished people as % of total population	Sustainable Society Foundation
		18. Obesity rate	Population (in %) with a BMI of 30	Social Progress Index
		19. Alcohol abuse	Adults (15+ years) with >60 grams of pure alcohol at least once in 30 days	World Health Organization (WHO)
	10. Equal opportunity	20. Gender wage gap	Difference between male and female median wages divided by the male median wages	OECD
		21. Female representation in parliament	Proportion of seats held by women in national parliaments (in %)	OECD
		22. Women presence on boards	Share of women on boards of directors in Forbes Global 500 companies	OECD
		23. Income distribution (GINI)	Estimated income distribution by the World Bank	The World Bank
	11. Education	24. Primary education, enrolment rate	School enrolment rate of children (in %)	World Economic Forum Global Competitiveness Index (WEF GCI)
		25. Quality of the educational system	Assessment of how well the educational system meets the needs of a competitive economy	World Economic Forum Global Competitiveness Index (WEF GCI)
		26. Youth in educational training	School enrolment rate (in %) of youth (15-19 years old)	OECD
		27. Adult literacy rate	Adult literacy rate as a % of population (15+ years)	The World Bank
	12. Living conditions	28. Access to electricity	Population (in %) with access to electricity	Environmental Performance Index (EPI)
		29. Access to an improved drinking water	Population (in %) using an improved drinking water source	Environmental Performance Index (EPI)
		30. Safe sanitation	Population (in %) with sustainable access to improved sanitation	Sustainable Society Foundation
		31. Road safety	Estimated road traffic fatal injury deaths per 100'000 inhabitants	Social Progress Index
	13. Social integration	32. Tolerance for homosexuals	Degree of tolerance for homosexuals	Social Progress Index
		33. Minority discrimination	Discrimination and violence against minorities	Social Progress Index
	14. Quality of life	34. Life satisfaction	Average self-evaluation on a scale from 0-10	OECD
		35. Quality of support network	Population (in %) with friends/relatives to rely on if needed	OECD Better Life Index
		36. Work-life balance	Employees (in %) whose usual hours of work per week are 50 hours or more	OECD Better Life Index
		37. Poverty among population	Poverty headcount ratio at national poverty lines (% of population)	The World Bank

Table 2. The GAPFRAME indicators and data sources: ***Society Dimension****.*

	ISSUE	INDICATOR		
		NAME	DESCRITPION	DATA SOURCE
ECONOMY	**15. Employment**	38. Job security	Employees (in %) with risk of losing job	OECD Better Life Index
		39. Youth unemployment	Youth unemployment, as % of total labour force ages 15-24	The World Bank
		40. Unemployment rate	Number of people seeking work and being long-term unemployed, as % of employed	Sustainable Society Foundation
		41. Slave labour	Proportion of the population in modern slavery	Global Slavery Index
	16. Resource use	42. Energy intensity	Cost of primary energy consumption, as % GDP	The World Bank
		43. Natural resources depletion	Adjusted savings: natural resources depletion multiplied by GINI coefficient	The World Bank
	17. Sustainable consumption	44. Carbon consumption / inhabitant	Carbon national production and transfers (imports and exports), in million tons of carbon / year, divided by inhabitants	Global Carbon Project
		45. Energy savings	Energy savings 2008-2012 in %	Sustainable Society Foundation
	18. Sustainable production	46. Irrigated agricultural land	Irrigated agricultural land as % of total agricultural land	The World Bank
		47. Companies with a sustainability report	Number of companies that complete a GRLI report, as % of all stock-quoted companies	KMPG
		48. Soundness of banks	Assessment of soundness of banks	World Economic Forum Global Competitiveness Index (WEF GCI)
	19. Innovation	49. Ease of access to loans	Assessment of how easy it is to obtain a bank loan with a good business plan and no collaterals	World Economic Forum Global Competitiveness Index (WEF GCI)
		50. Availability of latest technologies	Assessment to what extent latest technologies are available	World Economic Forum Global Competitiveness Index (WEF GCI)
		51. Internet users	Number of internet users as % of population	Social Progress Index

Table 3. The GAPFRAME indicators and data sources: ***Economy Dimension****.*

	ISSUE	INDICATOR		
		NAME	DESCRITPION	DATA SOURCE
GOVERNANCE	**20. Public finance**	52. Government debt	General government debt, as % of GDP	Sustainable Society Foundation
		53. Budget balance	Government budget balance, as % of GDP	World Economic Forum Global Competitiveness Index (WEF GCI)
	21. Structural resilience	54. Quality of overall infrastructure	Assessment of infrastructure (transport, telephony, energy)	World Economic Forum Global Competitiveness Index (WEF GCI)
		55. Tolerance for immigrants	Degree of tolerance for immigrants	Social Progress Index
		56. Public sector corruption	Perceived level of public sector corruption	Social Progress Index
	22. Peace & cooperation	57. Share of voice - Freedom of assembly	The extent to which freedoms of assembly and association are subject to actual governmental limitations or restrictions	Social Progress Index
		58. Freedom of movement	Both freedom to move domestically and abroad with right to return home	Social Progress Index
		59. Strength of legal rights	Collateral and bankruptcy laws protecting and facilitate lending	The World Bank
		60. Terrorism	Global terrorism, country ranking	Global Terrorism Index
	23. Business integrity	61. Ethical behaviour of firms	Assessment of ethical behaviour of companies with public officials, politicians and other firms	World Economic Forum Global Competitiveness Index (WEF GCI)
		62. Effectiveness of anti-monopoly policy	Assessment of extent to which anti-monopoly policy promotes competition	World Economic Forum Global Competitiveness Index (WEF GCI)
		63. Healthy business support	Number of procedures to start a business	World Economic Forum Global Competitiveness Index (WEF GCI)
	24. Transparency	64. Good governance	World Bank Index - total score	Sustainable Society Foundation
		65. Policy knowledge	The extent to which citizens are informed of government policymaking	Sustainable Governance Indicators (SGI)
		66. Legal certainty	The extent to which government and administration act on the basis of and in accordance with legal provisions to provide legal certainty	Sustainable Governance Indicators (SGI)
		67. Freedom of expression	Press Freedom Index	Social Progress Index
		68. Judicial independence	Assessment of degree of judicial independence from members of government, citizens, or firms	World Economic Forum Global Competitiveness Index (WEF GCI)

Table 4. The GAPFRAME indicators and data sources: ***Governance Dimension****.*

4.3. Data sources and data treatment

The indicator data was collected from various publicly available sources, including organizations like United Nations Environment Programme (UNEP), World Health Organization (WHO), Sustainable Society Foundation, The World Bank, and many others. The sources for all 68 indicators are listed in Tables 1-4.

The values for 63 indicators were downloaded and used directly for the GAPFRAME issues. An additional treatment of data was performed only on three indicators:

- Indicator no 5, *Phosphate consumption*, was divided by cultivated land to determine the level of fertilizers used in agriculture by country;
- Indicator no 43, *Natural resources depletion*, was multiplied by the GINI coefficient, to make the natural resources depletion independent of income or wealth distribution of a country's residents;

- Indicator no 44, *Carbon consumption*, was divided by the number of inhabitants per country to better compare the carbon consumption between nations.

Two indicators, for which we could not find publicly available data, were developed by ourselves in order to substantiate the GAPFRAME issues, as discussed in the following section.

4.4. Development of new indicators

We developed two new indicators based on publicly available data. These are: *Extinction rate of animal species* (Indicator no 1) and *Carbon quotient* (Indicator no 3).

4.4.1. Extinction rate of animal species

Although the global extinction rate of species is known, to the best of our knowledge there is no publicly available indicator that represents the extinction rate of species per country. In the GAPFRAME, we estimated the *Extinction rate of animal species* based on the IUCN Red List of Threatened Species data, in collaboration with experts in the field (see *Acknowledgments* section).

We have calculated the extinction rate of animals in E/MSY units (extinction per million species-years), using the following formula (Pimm et al., 2014):

$$Extinction\ rate\ of\ animal\ species = \frac{Number\ of\ animal\ extinction\ per\ country}{Average\ species\text{-}years} * 1000\ 000$$

To estimate the "*number of animal extinction per country*" we used the IUCN Red List data (IUCN, 2016a) and counted the total number of extinct (EX) and extinct in the wild (EW) animals per country.

We further calculated the "*average species – years*" by multiplying the total "*number of assessed species"* by country with the "*average years described to present*" that represents an average time elapsed since the species were discovered (Pimm et al., 2006):

$$Average\ species\text{-}years = Number\ of\ assesed\ species * Average\ years\ described\ to\ present$$

To estimate the "*number of assessed species*" by country, we used the IUCN Red list data (IUCN, 2016b) and summed up the total assessed endemic and non-endemic animal species that included: mammals, birds, crocodiles & alligators, chameleons, amphibians, groupers, sturgeons, wrasses & parrotfishes, sharks & rays, crabs, crayfishes, lobsters, cone snails, and reef-forming corals.

In the GAPFRAME V1, we calculated the "*average years described to present*" for two taxonomic groups: birds and fishes and used the average value (138 years) to calculate the "*average species-years*". In future, we plan to extend the calculations to more taxonomic groups in order to increase the precision in estimation of this parameter.

4.4.2. Carbon quotient

In the GAPFRAME process, we also developed the *Carbon quotient* indicator, based on the National Footprint Accounts (2016) data for ecological footprint and biocapacity.

The *Carbon quotient*, measured in global hectares per person, is defined as a country's carbon footprint divided by the average remaining global biocapacity:

$$Carbon\ quotient = \frac{National\ carbon\ footprint}{Remaining\ global\ biocapacity}$$

The "*remaining global biocapacity"* is calculated by subtracting the ecological footprint (consisting of the footprints from agriculture, grazing, forestry, fishing, and built land) from the total available biocapacity globally. Using the global rather than a country's remaining biocapacity serves to equalize different landmasses per nation, to prevent punishing unfairly a small densely populated country.

Ideally, the carbon footprint should stay within the limits of the remaining global biocapacity, implying the ideal value for the *Carbon quotient* must be below 1. More information on determination of the ideal values in the GAPFRAME is given in the section below.

5. Defining ideal values for the indicators (Step 3)

To approximate an ideal state of the world, we accepted the challenge to define ideal values (desired target values) for each indicator in the dataset. The definition of ideal target values is a very challenging process and requires full transparency about the ongoing efforts to verify and correct (if necessary) the defined values.

For the GAPFRAME V1 version, we defined the ideal and worst values by following two rules:

(1) Where possible, we respected the original scale and the target (ideal) and worst values associated with individual indicators and their data sources. For example, the Environmental Performance Indices (EPI) are measured on a 0–100 scale, with 100 being the target value to be achieved. Similarly, the Sustainable Governance Indicators (SGI) are measured on a 1–10 scale, with 10 being the target value and 1 being the worst value. In total, 37 GAPFRAME indicators (out of 68) have predefined target values in their original source.

(2) For indicators without specified target values (e.g., some of The World Bank or World Economic Forum GCI indicators), we defined ideal and worst values based on currently observed min and max values as well as by projecting ourselves into a desirable ideal state, following common sense. For example, we estimated the target ideal value for "Female representation in parliament" to be 50% (perfect gender equality) or for the *Gender wage gap* indicator to be 0% (no wage gap). For *Female representation in parliament*, we set the worst value at 10%, based on the smallest actual values in the world. For the *Gender wage gap* we set the worst value at 40%, based on the largest actual values in the world. Following a similar approach, we defined the ideal and worst values for 31 GAPFRAME indicators (out of 68). Tables 5-8 provide detailed information on how the ideal and worst values were set for each individual indicator in our framework. It is important to add that prior to the definition of the ideal/worst values, we removed the outlying values from the indicator datasets (*example*: for the *Extinction rate of animal species* indicator, we set the worst value at 100 although the actual value for USA is 700, which is overall an outlying value).

	ISSUE	INDICATOR				
		NAME	IDEAL VALUE	RATIONALE	WORST VALUE	RATIONALE
PLANET	**1. Biodiversity**	1. Extinction rate of animal species	2	Close to pre-industrial extinction rate. Based on smallest observable values	100	Close to largest observable values
		2. Protected terrestrial habitat areas	100	Indicator original scale is respected	0	Indicator original scale is respected
	2. Carbon quotient	3. Carbon quotient	0.9	Carbon footprint lower than available biocapacity	5	Close to largest observable values
	3. Oceans	4. Fish stock	100	Indicator original scale is respected	0	Indicator original scale is respected
		5. Phosphate consumption / cultivated land	0	No use of fertilizers. Based on smallest observable values	10	Close to largest observable values
	4. Land & forests	6. Soil quality	100	Indicator original scale is respected	0	Indicator original scale is respected
		7. Organic farming	20	Indicator target value is respected	0	Based on smallest observable values
		8. Land degradation (desertification)	0	No hazard of desertification. Based on lowest observable values	100	Based on largest observable values
	5. Clean air	9. Exposure to air pollution	100	Indicator original scale is respected	0	Indicator original scale is respected
	6. Water	10. Renewable water resources	10	Indicator original scale is respected	1	Indicator original scale is respected
		11. Water quality	100	Everyone is satisfied with water quality. Close to largest observable value	60	Based on smallest observable values
	7. Clean energy	12. Renewable energy	100	Indicator target value is respected	0	Based on smallest observable values
		13. Domestic use of solid fuels	0	Solid fuels are not used. Close to smallest observable values	100	Close to largest observable values
	8. Waste treatment	14. Recovered & recycled solid municipal waste	100	All waste can be recycled	0	Based on smallest observable values
		15. Treatment of waste water	100	Indicator original scale is respected	0	Indicator original scale is respected

*Table 5. Definition of ideal values and worst values for indicators in the **planet dimension**.*

	ISSUE	INDICATOR				
		NAME	IDEAL VALUE	RATIONALE	WORST VALUE	RATIONALE
SOCIETY	**9. Health**	16. Child survival	100	Indicator original scale is respected	0	Indicator original scale is respected
		17. Sufficient food	0	Indicator target value is respected	40	Close to largest observable values
		18. Obesity rate	0	No obesity problem	40	Based on largest observable values
		19. Alcohol abuse	0	No alcohol abuse	40	Based on largest observable values
	10. Equal opportunity	20. Gender wage gap	0	No gender wage gap	40	Based on largest observable values
		21. Female representation in parliament	50	Perfect gender balance	10	Based on smallest observable values
		22. Women presence on boards	50	Perfect gender balance	0	Based on smallest observable values
		23. Income distribution (GINI)	0	Indicator original scale is respected	100	Indicator original scale is respected
	11. Education	24. Primary education, enrolment rate	100	Enrolment is 100%. Based on largest observable values	60	Based on smallest observable values
		25. Quality of the educational system	7	Indicator original scale is respected	1	Indicator original scale is respected
		26. Youth in educational training	100	Enrolment is 100%. Close to largest observable values	50	Based on smallest observable values
		27. Adult literacy rate	100	Everyone can write and read. Based on largest observable values	30	Based on smallest observable values
	12. Living conditions	28. Access to electricity	100	Indicator original scale is respected	0	Indicator original scale is respected
		29. Access to an improved drinking water	100	Indicator original scale is respected	0	Indicator original scale is respected
		30. Safe sanitation	100	Indicator original scale is respected	0	Indicator original scale is respected
		31. Road safety	0	No fatal injuries. Close to smallest observable values	40	Based on largest observable values
	13. Social integration	32. Tolerance for homosexuals	1	Indicator original scale is respected	0	Indicator original scale is respected
		33. Minority discrimination	0	Indicator original scale is respected	10	Indicator original scale is respected
	14. Quality of life	34. Life satisfaction	10	Indicator original scale is respected	0	Indicator original scale is respected
		35. Quality of support network	100	People support and help each other. Close to largest observable values	70	Based on smallest observable values
		36. Work-life balance	0	Work-life balance is preserved. Based on smallest observable values	30	Based on largest observable values
		37. Poverty among population	0	No poverty. In accordance with SDGs	75	Based on largest observable values

*Table 6. Definition of ideal values and worst values for indicators in the **society dimension**.*

	ISSUE	INDICATOR				
		NAME	IDEAL VALUE	RATIONALE	WORST VALUE	RATIONALE
ECONOMY	**15. Employment**	38. Job security	0	No risk of loosing job. Close to smallest observable values	15	Based on largest observable values
		39. Youth unemployment	0	No unemployment. Close to smallest observable values	60	Based on largest observable values
		40. Unemployment rate	0	Indicator target value is respected	30	Based on largest observable values
		41. Slave labour	0	No slavery. Close to smallest observable values	1.5	Based on largest observable values
	16. Resource use	42. Energy intensity	2	Based on smallest observable values	20	Based on largest observable values
		43. Natural resources depletion	0	No depletion of natural resources. Based on smallest observable values	15	Based on largest observable values
	17. Sustainable consumption	44. Carbon consumption / inhabitant	0	Carbon consumption approaching zero. Value set by an expert	70	Based on largest observable values
		45. Energy savings	0.4	Based on largest observable values	-0.4	Based on smallest observable values
	18. Sustainable production	46. Irrigated agricultural land	0	No irrigation. Based on smallest observable values.	35	Based on largest observable values
		47. Companies with a sustainability report	100	All companies complete GRLI report. Based on largest observable values.	25	Based on smallest observable values
		48. Soundness of banks	7	Indicator original scale is respected	1	Indicator original scale is respected
	19. Innovation	49. Ease of access to loans	7	Indicator original scale is respected	1	Indicator original scale is respected
		50. Availability of latest technologies	7	Indicator original scale is respected	1	Indicator original scale is respected
		51. Internet users	100	Everyone can use internet. Close to on largest observable values.	1	Based on smallest observable values

*Table 7. Definition of ideal values and worst values for indicators in the **economy dimension**.*

	ISSUE	INDICATOR				
		NAME	IDEAL VALUE	RATIONALE	WORST VALUE	RATIONALE
GOVERNANCE	**20. Public finance**	52. Government debt	2.5	Indicator target value is respected	150	Based on largest observable values
		53. Budget balance	1	Budget with no deficit. Ideally, with a small surplus	-15	Based on smallest observable values (deficit)
	21. Structural resilience	54. Quality of overall infrastructure	7	Indicator original scale is respected	1	Indicator original scale is respected
		55. Tolerance for immigrants	1	Indicator original scale is respected	0	Indicator original scale is respected
		56. Public sector corruption	100	Indicator original scale is respected	0	Indicator original scale is respected
	22. Peace & cooperation	57. Share of voice - Freedom of assembly	2	Indicator original scale is respected	0	Indicator original scale is respected
		58. Freedom of movement	4	Indicator original scale is respected	0	Indicator original scale is respected
		59. Strength of legal rights	12	Indicator original scale is respected	0	Indicator original scale is respected
		60. Terrorism	0	Indicator original scale is respected	10	Indicator original scale is respected
	23. Business integrity	61. Ethical behaviour of firms	7	Indicator original scale is respected	1	Indicator original scale is respected
		62. Effectiveness of anti-monopoly policy	7	Indicator original scale is respected	1	Indicator original scale is respected
		63. Healthy business support	2	Ideally, only 2 procedures needed to start a new business. Based on smallest observable values	15	Based on largest observable values
	24. Transparency	64. Good governance	15	Indicator original scale is respected	-15	Indicator original scale is respected
		65. Policy knowledge	10	Indicator original scale is respected	1	Indicator original scale is respected
		66. Legal certainty	10	Indicator original scale is respected	1	Indicator original scale is respected
		67. Freedom of expression	0	Indicator original scale is respected	100	Indicator original scale is respected
		68. Judicial independence	7	Indicator original scale is respected	1	Indicator original scale is respected

*Table 8. Definition of ideal values and worst values for indicators in the **governance dimension**.*

6. Data processing: normalization and scaling (Step 4)

Once the ideal and worst values were determined for all the indicators, we could start the data normalization and scaling process. In the normalization operation, the actual values were compared to their reference values (i.e., their ideal and worst values). The scaling process aimed at transforming the data coming from various sources into a consistent dataset represented on the 0−10 point GAPFRAME scale.

The normalization and conversion of data into a 0−10 scale was performed by using the following approach:

(A) If the worst value of an indicator equals zero, we simply divide the indicator's current value by its reference ideal target value and we multiply the result by 10 (which is a scaling factor):

$$GAPFRAME\ indicator\ = \frac{Indicator\ current\ value}{Indicator\ ideal\ value} * 10$$

(B) If the ideal value of an indicator equals zero, we divide the indicator's current value by its worst reference value and we multiply it by 10 (a scaling factor). Then, we subtract the obtained result from 10 (the reversal method):

$$GAPFRAME\ indicator = 10 - \frac{Indicator\ current\ value}{Indicator\ worst\ value} * 10$$

(C) If the ideal and worst values of an indicator are different from zero, we normalize the indicator's current values prior to operations (A) or (B) as follows:

$$GAPFRAME\ indicator\ (A) = \frac{Indicator\ current\ value - Indicator\ worst\ value}{Indicator\ ideal\ value - Indicator\ worst\ value} * 10$$

or

$$GAPFRAME\ indicator\ (B) = 10 - \frac{Indicator\ current\ value - Indicator\ ideal\ value}{Indicator\ worst\ value - Indicator\ ideal\ value} * 10$$

Table 9 lists the formulas applied to convert all 68 indicators into the 0−10 GAPFRAME scale, illustrating the steps (A) – (C). In some cases, the normalization and scaling processes resulted in values that exceeded the GAPFRAME upper or lower scale limits. These outlying values were substituted with 10 and 0, respectively.

INDICATOR			FORMULA TO CONVERT INDICATOR DATA INTO THE 0-10 GAPFRAME SCALE
NAME	IDEAL VALUE	WORST VALUE	
			Scale with 10
Access to an improved drinking water	100	0	$= \frac{Indicator\ value}{Indicator\ ideal\ value} * 10$
Access to electricity	100	0	
Child survival	100	0	
Exposure to air pollution	100	0	
Fish stock	100	0	
Freedom of movement	4	0	
Organic farming	20	0	
Protected terrestrial habitat areas	100	0	
Public sector corruption	100	0	
Recovered & recycled solid municipal waste	100	0	
Renewable energy	100	0	
Safe sanitation	100	0	
Share of voice - Freedom of assembly	2	0	
Soil quality	100	0	
Strength of legal rights	12	0	
Tolerance for homosexuals	1	0	
Tolerance for immigrants	1	0	
Treatment of waste water	100	0	
Women presence on boards	50	0	
			Reverse and scale with 10
Alcohol abuse	0	40	$= 10 - \frac{Indicator\ value}{Indicator\ worst\ value} * 10$
Carbon consumption / inhabitant	0	70	
Domestic use of solid fuels	0	100	
Freedom of expression	0	100	
Gender wage gap	0	40	
Income distribution (GINI)	0	100	
Irrigated agricultural land	0	35	
Job security	0	15	
Land degradation (desertification)	0	100	
Minority discrimination	0	10	
Natural resources depletion	0	15	
Obesity rate	0	40	
Phosphate consumption / cultivated land	0	10	
Poverty among population	0	75	
Road safety	0	40	
Slave labour	0	1.5	
Sufficient food	0	40	
Terrorism	0	10	
Unemployment rate	0	30	
Work-life balance	0	30	
Youth unemployment	0	60	
			Normalize and scale with 10
Adult literacy rate	100	30	$= \frac{Indicator\ value\ - Indicato\ \ worst\ value}{Indicator\ ideal\ value\ - Indicator\ worst\ value} * 10$
Availability of latest technologies	7	1	
Companies with a sustainability report	100	25	
Ease of access to loans	7	1	
Effectiveness of anti-monopoly policy	7	1	
Ethical behaviour of firms	7	1	
Female representation in parliament	50	10	
Good governance	15	-15	
Internet users	100	1	
Judicial independence	7	1	
Legal certainty	10	1	
Policy knowledge	10	1	
Primary education enrolment rate	100	60	
Quality of the educational system	7	1	
Quality of overall infrastructure	7	1	
Quality of support network	100	70	
Renewable water resources	10	1	
Soundness of banks	7	1	
Water quality	100	60	
Youth in educational training	100	50	
			Normalize, reverse and scale with 10
Budget balance	1	-15	$= 10\ - \frac{Indicator\ value\ - Indicator\ ideal\ value}{Indicator\ worst\ value\ - Indicator\ ideal\ value} * 10$
Carbon quotient	0.9	5	
Energy intensity	2	20	
Energy savings	0.4	-0.4	
Extinction rate of animal species	2	100	
Government debt	2.5	150	
Healthy business support	2	15	
			No data conversion
Life satisfaction	10	0	

Table 9. Formulas to convert indicator values into the 0–10 GAPFRAME scale.

7. Calculating the GAPFRAME Index (Step 5)

The GAPFRAME Index calculation is based on an aggregation of the normalized and scaled indicators. In the V1 version of the framework, the GAPFRAME Index was calculated and visualized for 155 countries (out of 196 initially considered), 22 regions, and the world, for which sufficient data was collected across all dimensions to generate an index (see more details in *section 9.2*).

7.1. Data aggregation

To calculate the GAPFRAME Index for a country, region or the world, we aggregated data from the indicators that substantiate the GAPFRAME issues and dimensions. The aggregation of data was based on the arithmetic mean of the normalized and scaled indicators, giving equal weight to all indicators within an issue, and to all issues in a dimension.

Since very few indicators provide regional or world values, we calculated them in our framework in order to construct the GAPFRAME Index for the world and for regions. We thus calculated the GAPFRAME regional indicator values as a weighted arithmetic mean of respective country values, with country inhabitants used as weight:

$$\begin{aligned} &Regional\ indicator\ weighted\ mean\ value \\ &\quad = SUM(country\ (1)\ ind.value * country\ (1)\ inhabitants, country\ (2)\ ind.value \\ &\quad * country\ (2)\ inhabitants, \dots, country\ (n)\ ind.value * country\ (n)\ inhabitants,) \\ &\quad / SUM(inhabitants\ (1), inhabitants\ (2), \dots, inhabitants\ (n)) \end{aligned}$$

To calculate a regional or world value for a given indicator, we set a rule that data for at least the 60% of respective countries had to be available.

7.2. The GAPFRAME Index score

Once the indicator data was aggregated into respective issues and dimensions, we could start calculating the GAPFRAME Index.

The GAPFRAME Index score was defined as the lowest value of all four dimensions: planet, society, economy and governance:

$$GAPFRAME\ Score = MIN(planet, society, economy, governance)$$

This deliberate decision for the lowest of the four dimensional scores reflects strong sustainability approach, implying that one dimension should not be improved at the cost of another dimension. Using the average of the 4 dimensions instead would suggest a “weak sustainability” approach whereby one dimension could be sacrificed in favor of another dimension (e.g. the environment at the expense of economic concerns). Using the lowest score ensures focusing on the sore spots. And this is precisely the purpose of the GAPFRAME: to highlight the biggest gap for a country between its current state and the desired ideal future state. We thus provide an *Average of 4 Dimensions* value only as an additional reference point, but do not use it for any ratings and rankings:

$$Average\ of\ 4\ Dimensions = AVERAGE(planet, society, economy, governance)$$

Figure 4 presents the world maps based on the (A) *GAPFRAME Score* and the (B) *Average of 4 Dimension* assessment, in order to visualize the difference between these two approaches. The GAPFRAME lowest score approach results in a less pleasant global picture, indicating a higher urgency to address the identified priority issues.

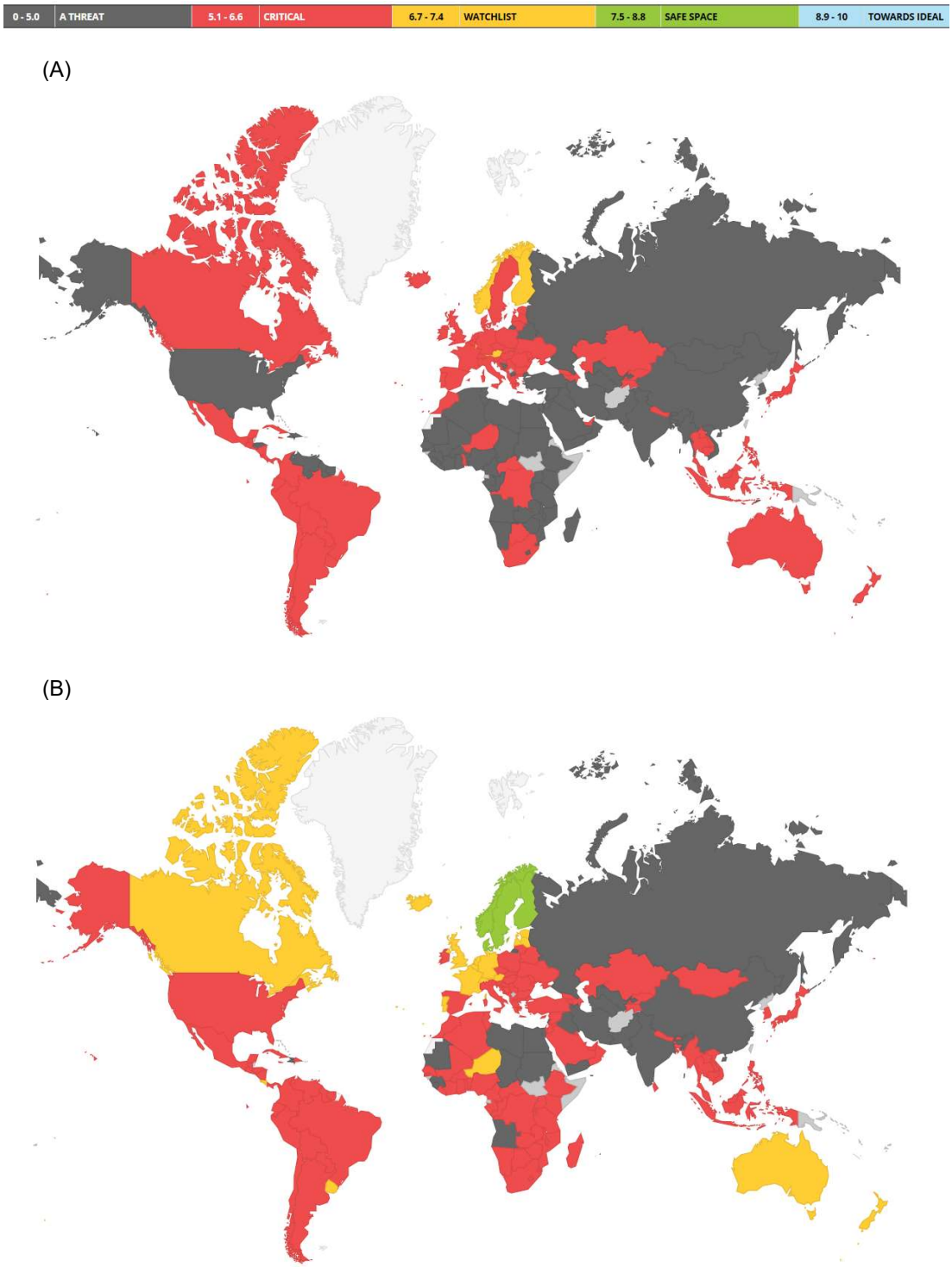

Figure 4. The GAPFRAME country performance using the (A) "GAPFRAME Score" assessment and the (B) "Average of 4 Dimensions" assessment.

7.3. The GAPFRAME Index score visualization

To visualize the GAPFRAME Index score at an individual country level, we have created a country stamp, as illustrated in Figure 5.

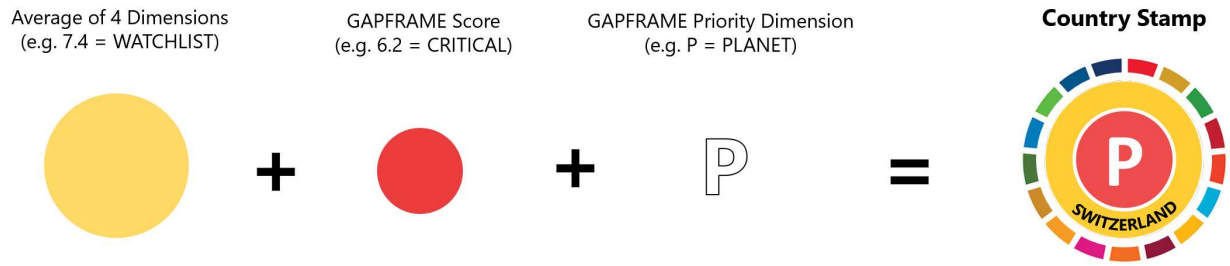

Figure 5. The GAPFRAME country stamp for Switzerland – an example of the GAPFRAME score visualization.

A country stamp consists of two circles: an outer and an inner circle which correspond to the "*Average of 4 dimensions*" and the "*GAPFRAME Score*" assessment, respectively. The inner circle contains a letter that refers to the priority dimension (i.e., the "weakest" dimension) that needs to be most urgently addressed at a country level. The colors of the inner and outer circles (yellow and red in the example of Switzerland, Fig. 5) refer to the GAPFRAME 0−10 point scale, as explained in detail in the next section.

8. Defining the GAPFRAME scale (Step 6)

In the GAPFRAME, the performance of countries, regions and the world are measured on the 0−10 point color scale, as illustrated in Figure 6.

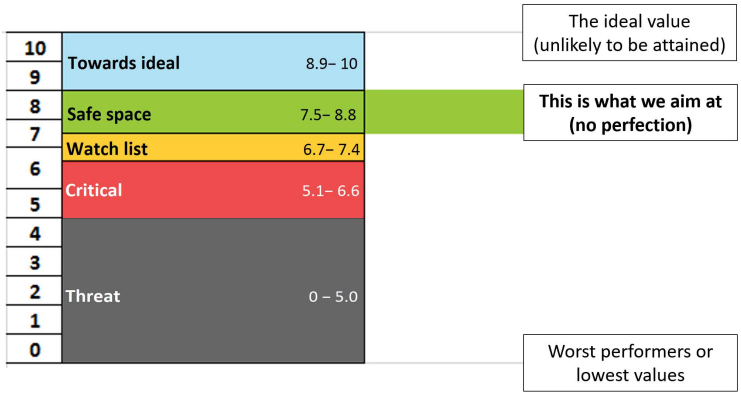

Figure 6. The GAPFRAME scale and its five levels: "Threat", "Critical", "Watch list", "Safe space", and "Towards ideal".

The GAPFRAME scale is inspired by the idea of a "safe operating space" as developed by Raworth (2012). Her model suggests that there is certain safe space within which humanity must operate, considering both outer planetary boundaries (Rockström et al., 2009) as well as certain minimum levels of social achievements to ensure that all 9 billion citizens can live well on one planet (WBCSD, 2010).

Consequently, rather than a 0 – 10 point scale, with 10 representing the ideal value to be imperatively achieved, we defined a "safe space" lying between a minimum required value ("watchlist") and an ideal state. Applying the commonly used 80/20 rule, we located the "safe space" at roughly 80% of the ideal state and have defined a range of 75−88% as the lower and upper measures for the safe space. Hence, the "safe space" does not represent the maximum or ideal value, but it can be considered as "good enough" for the future state to be attained.

With the "safe space" being central for the GAPFRAME scale, we defined the GAPFRAME classification levels as follows:

Threat (0 – 5; grey): Any issue with a value resulting from the average of the underlying indicators below 5 is considered a burning issue that represents a threat for that country and for humanity: significant improvement and urgent attention is needed to drive change towards the safe space.

Critical (5.1 – 6.6; red): Any issue with values between 5.1 and 6.6 is considered as critical and risky for humanity, therefore, an immediate action needs to be undertaken to improve the current situation.

Watch list (6.7 – 7.4; yellow): Any issue with an average value between 6.7 and 7.4 is considered as being on the watch list. This zone (level) is close to the "safe space", indicating a need for closer examination to determine if things are indeed moving in the right direction.

Safe space (7.5 – 8.8; green): We define a range from 7.5 to 8.8 as a "safe space". The safe space does not represent the maximum or ideal value of a given issue or dimension but it can be considered as "good enough".

Towards ideal (8.9 – 10; blue): Any value above 8.8 is considered approaching an ideal state, which we do not particularly highlight for not suggesting to stakeholders to spend their 80% of efforts required to advance the last 20% to perfection. We rather want to draw the attention to those issues that need urgent action (i.e. those below 6.7).

9. Limitations of the GAPFRAME V1 version

The GAPFRAME V1 version is a first attempt to develop a composite index which compares the current state of the world to its ideal future, based on an integral approach that embeds four sustainability dimensions: environment, society, economy and governance. We acknowledge that this version has limitations that must be progressively addressed in order to develop an increasingly robust index.

At this point of time, we see the main shortcomings of the GAPFRAME V1 version in the following four areas: selection of indicators, treatment of missing data, determination of target values, and index robustness, as discussed in detail below.

9.1. Selection of indicators

Despite our effort to identify the best possible indicators, the final set of 68 indicators is far from satisfactory. The main limitation to the GAPFRAME V1 version is that it includes indicators with insufficient data. 18 out of 68 selected indicators provide national values for less than 60% of the considered countries (thus less than 118 countries). Moreover, 11 indicators out of these 18 provide data for less than 45 countries, often restricting data to OECD countries. Being aware of this limitation, we temporarily include

the indicators with insufficient data as long as they are pertinent to the issues. In the next revision round of the framework, we plan to complete the set of 68 indicators and replace those with insufficient data.

We also plan to revise and complete the allocation of indicators to our 24 issues. Currently, some issues are only partially covered by the available indicators. The best example is the *Clean Air* issue which is based on only 1 indicator, *Exposure to air pollution (PM25)*, that covers a very narrow aspect of the issue. This issue needs to be completed in order to cover the air pollution problem more broadly.

To account for the potential overlaps between indicators, we would have liked to use the principal component analysis (PCA). However, since the satisfactory indicators data set has not yet been defined, we decided to postpone this analysis to a new framework revision round in which experts will review and amend the current indicators choices.

9.2. Treatment of missing values

There are a lot of data gaps in the current version of the GAPFRAME. Imputing the missing data with replacement values (coming from mean substitution, correlation results, time series or other methods), and treating these as if they were observed, would be the optimal way to treat the missing values in the dataset. However, since we have not yet collected the historical data for the indicators, we are not able to estimate the missing values using statistical methods based on past values. To diminish uncertainty when imputing missing data based on partially collected information, we ultimately decided to ignore the missing data and analyse only the available data in the GAPFRAME V1 version.

Consequently, the GAPFRAME *Score* and the *Average of 4 Dimensions* were calculated only if sufficient data for at least three dimensions existed. As a result, the GAPFRAME score was calculated only for 155 out of the 196 countries initially considered.

The dimensions were calculated if at least 60% of the data existed for related issues. As a consequence, the planet dimension was evaluated for 178 countries, the society dimension for 143 countries, the economy dimension for 159 countries, and the governance dimension for 155 countries.

The issues were calculated if at least 50% of the data existed for related indicators. Most issues were calculated for at least 130 countries. The exceptions are the *Equal opportunity*, *Quality of Life*, and *Sustainable production* issues that were calculated for only 43, 36, and 81 countries, respectively. This limitation comes from the fact that for some indicators data was available mainly for the OECD countries.

To calculate the indicators, issues and dimensions for the regions and the world, we required data for at least 60% of the respective countries. Thus, to evaluate the world value for any indicator, issue, or dimension we needed to collect data for at least 118 countries; for the OECD, for at least 21 countries.

9.3. Determination of target values

Determination of ideal target values as well as worst values for all chosen indicators is a challenging process and demands an ongoing multi-expert effort to check and improve these values and how they are defined. A reason for using the opinions of several experts when determining ideal values for indicators was that a group approach may provide a broader perspective when defining an ideal case for a given indicator. Consequently, in the GAPFRAME, we rely on a multi-consultation process with experts to determine ideal values for indicators that reflect the desired future state of the world. The determination of ideal values for

indicators is a non-trivial task as it is based on collecting subjective opinions which inherently introduce bias and uncertainty.

To simplify the process, where possible, we respected the target values inherent to the indicators sources and their respective scales. A drawback of this approach lays in the difficulty in obtaining uniform data and metrics across all indicators. Some indicators may provide target values based on the highest observed value or other metrics, and not necessarily on the ideal value to be achieved. Let's take for example the *Exposure to air pollution (PM25)*, an indicator taken from the Environmental Performance Index (EPI), to illustrate this point. This indicator refers to suspended particles in the air (2.5 microns diameter) that contribute to acute lower respiratory infections and other diseases such as cancer. Average annual concentrations of greater than 10 $\mu g/m^3$ are known to be injurious to human health. For this indicator, the low-performance benchmark is 49.92 $\mu g/m^3$, which is based on the worst actual values, whereas the high-performance benchmark is set at 10 $\mu g/m^3$. As a result, all countries with 10 $\mu g/m^3$ (or lower) concentration levels get the EPI score of 100 being the highest possible score (target score) on the 0-100 EPI scale. And here the question arises: should we consider the 100 score as an ideal value to be achieved if this score corresponds to particles concentration of 10 $\mu g/m^3$ which is already an injurious limit for the health? Shouldn't we aim higher?

Similar reasoning could be used with all the indicators, analysing the indicators raw data and the way they were aggregated, normalized and scaled. In fact, we could have used the indicator raw data instead of the transformed (normalized) data, introducing uniform metrics across all of them to determine the ideal and worst values and subsequently, proposing adequate normalization and scaling process. This however is a time and labour consuming process, which was not within the scope of the GAPFRAME V1 version. We might consider this approach in the next framework revision round.

9.4. Robustness of the index

The robustness of the GAPFRAME Index is yet to be evaluated and that is one of the major limitations of the GAPFRAME V1 version. The sensitivity and uncertainty analysis is planned to be performed within the next framework revision round in order to test the efficacity and robustness of the proposed tool.

10. Future Developments

The validity and the usefulness of the GAPFRAME will come from an expansion of its users and applications. We see the GAPFRAME as an ongoing process in which we look forward to receiving and including feedback and comments in next iterations of the GAPFRAME. After the publication of the data in 2017 and an extended round of use and applications, an expert panel will be formed to review indicator by indicator, issue by issue, dimension by dimension, total results and scores in order to integrate further improvements and amendments. A bi-annual revision and upgrade of the framework is an integral part of how its relevance can and must be assured in the coming years.

In a next step, we will also add historical data to our dataset in order to enable trend data analysis and related system-thinking tools including loop diagrams highlighting levels of change. This will enable us to assess not only where a country is in a given period of time (now) but to understand if a country is moving in the right direction (towards the safe space or away from it) in any given issue and sustainability dimension. An integral approach taken in the GAPFRAME allows to study interlinkages and the dynamics across all four

sustainability dimensions (planet, society, economy, and governance) what may increase comprehensibility of this complex system.

11. Conclusions

According to the Globescan Sustainability Survey 2017 (GlobeScan and SustainAbility, 2017), "only a very small proportion of surveyed professionals (9%) feel positive about the progress made to date in the transition to sustainable development, suggesting a tremendous amount of work remains to be done in this area". Moreover, "sustainability experts view NGOs as having contributed the most toward progress on the Sustainable Development Goals to date, followed by social entrepreneurs, the UN, citizen-led mass social change movements and academics. In contrast, national governments and the private sector are perceived as having contributed very little".

In the light of these findings, we see the GAPFRAME as a tool to enhance the implementation of the Agenda 2030 for Sustainable Development, and to monitor developments thereafter. The framework invites all stakeholders (e.g., business, governments, citizens, non-profit organization, etc.) to focus attention on addressing identified priority issues at a national level, holding each country accountable for the successful implementation of the global sustainability targets within their area of responsibility. The framework is particularly suited for business since it can be used as a strategic business tool to identify long-term business opportunities, as extensively discussed in a previous publication (Muff et al., 2017). Within the proposed framework, we aim to provide decision-makers with aggregated information on local and regional situations to assist them in their decision-making process and to enhance the multi-stakeholder collaboration across the globe.

We invite you to use and apply the data published for 196 countries and 22 regions on www.gapframe.org and to share your feedback and comments with us, including an interest to become a part of the multiple expert panels we are setting up to upgrade the V1 version of the framework in 2018 and thereafter.

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