The Water-Energy-Food Nexus Index: A Tool for Integrated Resource Management and Sustainable Development

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Abstract

The Water-Energy-Food (WEF) nexus has, in the past decade, gained prominence as an approach for assessing integrated resource management. One challenge related to the WEF nexus approach is how to represent and monitor it since a system that includes water-, energy- and food-related parameters is complex. Not only are these resources quantified utilising different units, but they vary both spatially and temporally.

This paper presents a national-level composite indicator that has been established for 170 countries, utilising the methodology developed by the *Joint Research Centre: Competence Centre on Composite Indicators and Scoreboards*. Following an assessment of 87 globally applicable water-, energy- and food-related indicators, 21 were selected to constitute the WEF Nexus Index. This index is made up of three equally weighted pillars representing the three constituent resource sectors, and six sub-pillars. A core element in the development of this index is equitable access to resources, which is characterised by each resource sector's 'access' sub-pillar.

The WEF Nexus Index provides a quantitative perspective and offers a lens for evaluating trade-offs to be considered in the pursuit of sustainable development. To this end, it is intended for assessing national progress relating to integrated resource management as well as supporting decision making and policy development. The relevance and usefulness of the outcomes are demonstrated through an assessment of South Africa.

The development of the WEF Nexus Index has demonstrated that no country is undertaking integrated resource management flawlessly. Every nation has the potential for improvement; which is evidenced by, for example, the top-ranking country for the index needing to reduce CO_2 emissions. Neither the composite indicator nor the WEF nexus approach is, however, the panacea that will solve all the significant development or environmental challenges facing the global society. It can, however, contribute to integrated resource management and is

complementary to the Sustainable Development Goals. It should ideally be utilised as an entry point into the underlying pillars, sub-pillars and indicators, in parallel with other qualitative and quantitative studies.

1 Introduction

An increase in food prices is considered to be a critical indicator of escalating natural resource scarcity, and the present century has witnessed numerous spikes in this regard (Mohtar and Daher 2012, Ringler et al. 2013). Predictions are that the global demand for resources such as water, energy and food are going to escalate dramatically in the coming decades (Beddington 2009, World Economic Forum 2011, National Intelligence Council 2012, WWF and SABMiller 2014). This increasing demand is being driven by a worldwide population that continues to grow exponentially; not only in numbers but also in consumption patterns, primarily due to a burgeoning middle class and urbanisation (FAO 2018). A further stressor is that the international supply chain system must deliver products and resources on a planet where predominant risks include extreme weather events, natural disasters, the failure of climate change mitigation and adaptation, and water crises (World Economic Forum 2018). The solemn nature of this situation is underscored by the warning of Steffen et al. (2018) who state that "the Earth System may be approaching a planetary threshold that could lock in a continuing rapid pathway toward much hotter conditions." Salam et al. (2017) argue that "The gap between future availability and demand can be closed not through the discovery of more water supplies but through effective demand-side management, which will need effective policy interventions."

Following the 2008 financial crisis, concerns were raised that if finite resources such as water are not effectually managed, then the environment, livelihoods and economic development will be adversely impacted (Beddington 2009, Rockstrom et al. 2009, Beddington 2010). The water, energy and food security trilemma (Wong 2010) was also highlighted, and since 2011 significant attention has been given to the Water-Energy-Food (WEF) nexus in the academic, policy, regulatory and development fraternities. The *Bonn2011 Conference* (Hoff 2011) and the World Economic Forum's publication *Water Security: The Water-Food-Energy-Climate Nexus* (World Economic Forum 2011) were enormously influential in this regard. In the past decade, the WEF nexus has emerged as a multi-centric lens for assessing integrated resource management and sustainable development (Weitz et al. 2017, Simpson and Jewitt 2019a).

The word *nexus* means to 'connect' (De Laurentiis et al. 2016). The view that water resources, energy generation and food production are interdependent is not novel (Allouche et al. 2015, Muller 2015, Wichelns 2017). Sušnik (2018) argues that the earliest global study on a nexus was the publication *The Limits of Growth* (Meadows et al. 1972). A critical motivation for considering the WEF nexus approach is that it is multi-centric, with each sector having equal importance (Abdullaev and Rakhmatullaev 2016, Gallagher et al. 2016, Benson et al. 2017, Liu et al. 2017). One goal of nexus studies is that the trade-offs resulting from policy development in institutional 'silos' will be reduced (Belinskij 2015).

The WEF nexus approach has, however, not been without criticism, with Cairns and Krzywoszynska (2016) considering it to be a "buzzword". Several recent publications have argued that the approach has not lived up to its potential (Albrecht et al. 2018, FAO 2018, Galaitsi et al. 2018). Their critique may be summarised in the statement by McGrane et al. (2018) that the nexus fraternity must migrate from 'nexus thinking' to 'nexus doing.' The nexus should, therefore, be quantified and operationalised as opposed to merely being a philosophical approach or framework. The imperative to integrate quantitative and qualitative nexus

assessments has been highlighted in recent literature (FAO 2018, Galaitsi et al. 2018, Allouche et al. 2019, Hoff et al. 2019, Simpson and Jewitt 2019b).

An additional motive for pursuing the WEF nexus is that it is a mechanism for achieving the relevant sector-related Sustainable Development Goals (SDGs), i.e. SDGs 2 (zero hunger), 6 (clean water and safe sanitation), 7 (affordable and clean energy) and 13 (climate action). Brouwer et al. (2018) contend that "the Nexus concept is a sound tool to support the sustainable management of resources across sectors, suitable for addressing the challenge of the next few years, namely achieving the Sustainable Development Goals." Ringler et al. (2013) suggested that the SDGs would present a crucial test for implementing the nexus approach at an international level. Yet to date "no country is on track to achieve all the goals by 2030" (Sachs et al. 2018).

While there has been a considerable effort to develop tools to monitor progress towards the SDGs (Sachs et al. 2019), there is less progress in assessing trade-offs between different SDGs or resource sectors such as those represented by the WEF nexus. Human society is at the centre of the global supply chain system while also being the regulator of this multifaceted framework. The linkages, inequalities, synergies, trade-offs, and limits to growth associated with the nexus must be monitored, understood, communicated, managed and regulated. A means of indicating whether a country is achieving a balance in securing these three resource sectors and monitoring progress (or regress) over time would be an invaluable policy tool.

2 Measuring of the WEF Nexus

Despite there being a stark disparity in the distribution of wealth as nations developed, researchers started to realise almost a half-century ago that there are limits to anthropogenic progress (Meadows et al. 1972). The global society has recognised that resources such as agricultural land, minerals and water are finite. Various indicators were developed to monitor aspects related to economics, development, the environment and sustainability. The required data are collected by national statistical offices, development organisations and research institutions. The Gross Domestic Product (GDP) was one of the first indicators that was extensively utilised.

Evaluating and communicating the level of trade-off between the water, energy and food sectors is complicated because the individual sectors within this system are quantified with different units of measurement (de Loë and Patterson 2017, Wichelns 2017). They also vary spatially and temporally. One means of assessing such a multifaceted system is through the development of a composite indicator (or index), which results "when individual indicators are compiled into a single index on the basis of an underlying model" (OECD 2008). The methodology set out by the Joint Research Centre's *Competence Centre on Composite Indicators and Scoreboards* (JRC:COIN) has been adhered to in this study (Saisana et al. 2018). The JRC:COIN have been involved in over 60 statistical audits of composite indicators, amongst others, the Environmental Performance Index (Yale University, Columbia University), the Global Innovation Index (INSEAD & World Intellectual Property Organisation), the Commitment to Reducing Inequality Index (Oxfam), the Financial Secrecy Index (Tax Justice Network), the Multidimensional Poverty Assignment Tool (UN International Fund for Agricultural Development), the Global Competitiveness Index (World Economic Forum), and the Corruption Perceptions Index (Transparency International) (Saisana et al. 2018).

The JRC:COIN's methodology requires that a conceptual framework be developed for the context under assessment. This framework is subsequently utilised to guide the selection of a

set of relevant and available indicators. These indicators are normalised, weighted and aggregated, thereby yielding a unitless index that represents the context being appraised. This index is complementary to the underlying data and represents it in a coherent manner. The index is also an access point to the complex data set upon which it is based, thereby enabling the identification of patterns and trends. Indices must be developed sensibly and transparently, and used responsibly, since they can be misused (Saisana et al. 2018). **Figure 1** shows that indicators and indices are developed from data to yield information that can ultimately be used for decision- and policy-making. As knowledge is developed, it can, in turn, influence the data collection and indicators for refining the process. Other quantitative and qualitative studies can augment the information generated, and various feedback loops can improve and optimised the data gathering process.

Many composite indicators have been developed in the last three decades (Sullivan 2002, Abeyasekera 2003, Jha and Murthy 2003, Esty et al. 2005, Waas et al. 2014, Sachs et al. 2016, de Vito et al. 2017, Transparency International 2018, Wendling et al. 2018). Some groupings, for example, advocacy groups, view composite indicators as a valuable tool to further their causes. Others, such as cautious professional statisticians, are wary of composite indicators due to the potentially subjective nature of the selection of the constituent indicators, the method of aggregation, the weighting of the indicators, and the interpretation thereof (Saisana et al. 2018).

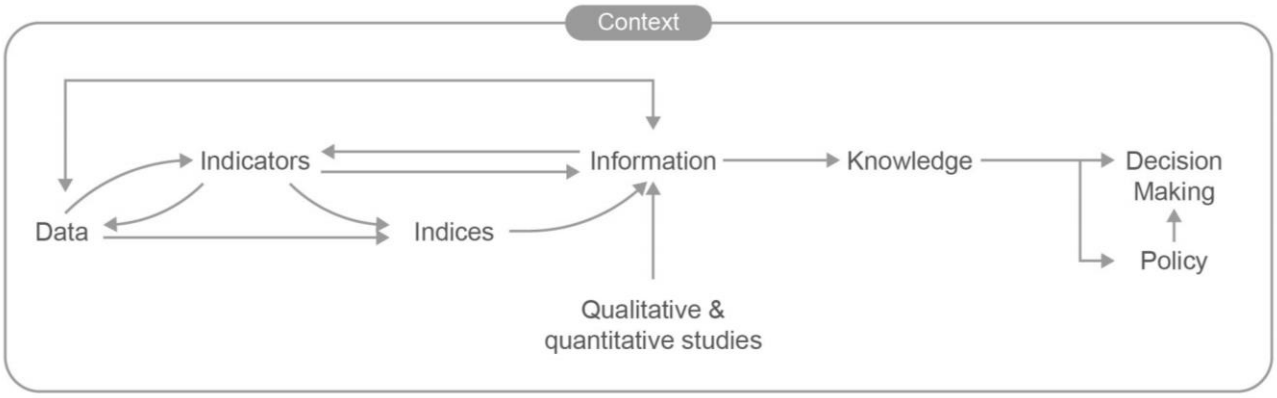

Figure 1: From data to decision making; modified from Segnestam (2002) and Waas et al. (2014)

3 Methodology

This section describes the methodology associated with the development of the WEF Nexus Index (Simpson et al. 2020). Associated with this academic paper are four addendums:

- *Addendum A*: The indicator selection table, which presents the 87 indicators reviewed in the development of the WEF Nexus Index, as well as their definitions, source, data adequacy, reference year, and a motivation of why each indicator was, or was not, included in the composite index.
- *Addendum B*: The untreated indicator data table includes the published data (e.g. by the World Bank, International Energy Agency (IEA) and the Food and Agriculture Organization of the United Nations (FAO)) for the 21 indicators that constitute the WEF Nexus Index, for the 170 nations that have adequate data.
- *Addendum C*: A table presenting the conceptual framework associated with the WEF Nexus Index's composition. This table includes the index, pillars, sub-pillars and indicators with each of their weights, forms of aggregation, and directions.

- *Addendum D*: A dashboard developed from the treated data. The published data for the 21 indicators have been treated by normalising each of the data sets (using the min-max method (OECD 2008, Saisana et al. 2018)) so that they conform to a range from 0-100. The normalising of the data is also necessary to ensure that each indicator's data set is unitless such that it can be combined in the composite indicator. The data treatment includes the minimising of the distorting effect of outliers on the data using statistical methods, which are described in this article. The dashboard has different colours for the treated data for each indicator in the following ranges: 0-25%; 25-50%; 50-75%; and 75-100%.

3.1 Hypothesis

A hypothesis related to this study is that there is sufficient, relevant water-, energy- and food-related indicator data to develop a global, country-level WEF nexus-based composite indicator that can be utilised for assessing the status of integrated resources management. This index would not be a one-size-fits-all solution to solving integrated resource challenges. Rather, the WEF Nexus Index provides an entry point for nexus assessments that seeks to meets the guidance of Hoff et al. (2019), i.e. aiming to create "a level playing field for all sectors while at the same time having sustainability (as defined in the SDGs) as an overarching aim." How this goal is operationalised and met would, however, depend on the unique case and the actors involved.

The purpose of the development of the WEF Nexus Index is to develop a country-level quantitative, integrated measurement of resource security as it relates to access to, and availability of, water, energy and food. It provides a measure of the degree of achievement of SDGs 2, 6, 7 and 13. It is a tool, lens and means for initiating integrated resource management, not as an end in itself. It is supported by a strong emphasis on data visualisation and representation.

3.2 Development of the framework

According to the JRC:COIN, the first step in forming a composite indicator is the development of a framework for the system under assessment (Saisana et al. 2018). To this end, the anthropocentric WEF nexus framework, presented in **Figure 2**, was utilised as the basis for the WEF Nexus Index's construction. At the core of this framework is human society, i.e. Anthropos (Greek for *human*), with its insatiable demand for resources. Globally, access to resources such as water, energy and food is not equitable, hence the inclusion of three water-, energy- and food-related SDGs in this framework. Each SDG has targets that "are universally applicable and aspirational" (UN Water 2018). SDG 6, for example, has eight global targets. The framework also reflects the priorities of the global South in achieving both access to and provision of resources (Simpson et al. 2020).

Further, these resources are procured from the environment in manners that are either renewable or non-renewable. The environment, land and climate are represented by the outer layers of this framework since, in many cases, planetary boundaries are being tested or even exceeded (Steffen et al. 2018). The framework also demonstrates that while humanity is at the centre of the global supply chain system, they are also custodians of the governance and policies related to these three interdependent resources.

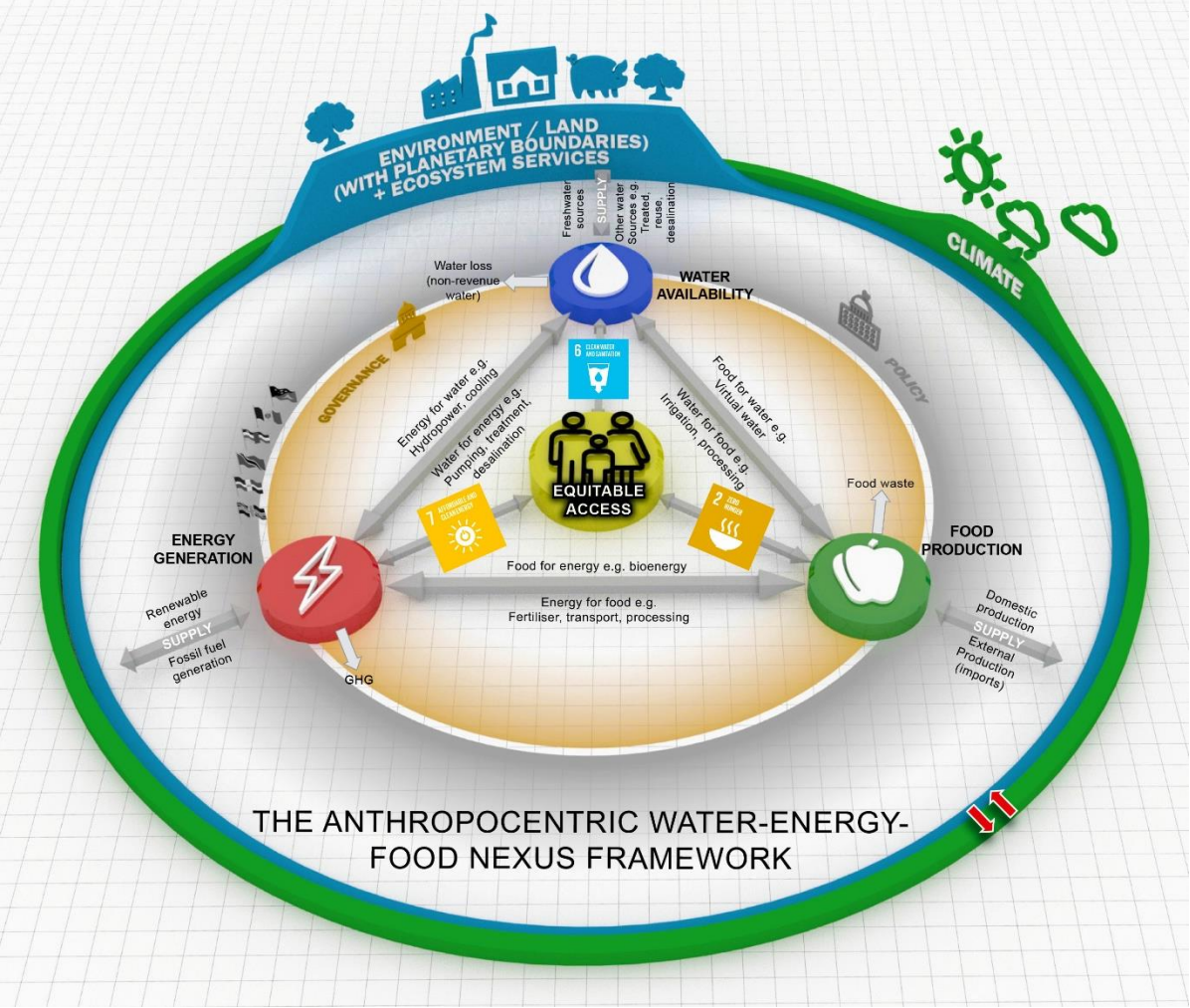

Figure 2: The Anthropocentric Water-Energy-Food Nexus Framework (Simpson et al. 2020)

Based on this framework, the WEF Nexus Index has three equal pillars representing water, energy and food, as presented in **Figure 3**. Each of these resource sectors, in turn, have "Access" and "Availability" sub-pillars. The "Access" component of the WEF nexus relates to the urgent need for worldwide distributional justice, i.e. equitable access to resources. This is the perspective from which the WEF Nexus Index was developed (Simpson et al. 2020). While equitable access to resources is essential, the physical availability thereof is of equal importance. The energy-access pillar, therefore, includes an access indicator, two indicators that represent renewable energy consumption and output and an indicator related to CO_2 emissions per capita (refer to **Figure 3**). This is because this pillar relates to SDGs 7 and 13, i.e. access to modern energy that addresses climate action.

3.3 Selection of indicators

The next stage in the development of a composite indicator, according to JRC:COIN, is the selection of the indicators that will constitute the index. The framework and index, pillar and sub-pillar structure developed for the system under assessment were utilised to guide the selection of the indicators presented in **Figure 3**. Internationally, data are collected by various organisations such as national statistical offices, government departments, non-governmental organisations and international organisations such as the World Bank, FAO, IEA and World

Health Organisation (WHO). A global search of these databases resulted in a list of 87 water-, energy- and food-related indicators that were subsequently reviewed for both relevance and data availability at a national scale via a rigorous and iterative process. For an indicator to be included in an index, at the indicator level at least 65% of countries should have valid data. Similarly, and at the country level, at least 65% of indicators should have valid data (Saisana et al. 2018).

Selection criteria included relevance, added value, data availability, and reliability, together with a correlation analysis to identify possible aggregation issues or double-counting (Simpson et al. 2020). If the correlation of the indicators is too high, taken to be equal to or greater than 0.92 in this study, then this constitutes double-counting, i.e. effectively including the same variable twice (OECD 2008). In this case one of the highly correlated indicators was omitted from the WEF Nexus Index.

Details of each indicator evaluated, and a rationale for its inclusion or exclusion in the WEF Nexus Index is provided in **Addendum A**. One of the challenges experienced in the selection of indicators is that there are very few indicators that measure the linkages between the constituent sectors, i.e. 'nexus' indicators that measure water for energy, water for food, energy for water, etc. Where these 'nexus' or 'integrated' indicators do exist, they are invariably reported by too few countries to form part of the index. These indicators could, however, form part of an in-depth study for countries that report these parameters.

Both the anthropocentric framework (refer to **Figure 2**) and the selection of indicators to form the WEF Nexus Index were presented at various forums during this project to facilitate stakeholder/expert engagement. These interactions proved to be beneficial in obtaining vital input on both the interpretation of the framework and the final selection of indicators. The forums that the conceptual framework and indicators were presented at include:

- A Research-on-Tap Seminar entitled "Towards a Water-Energy-Food Nexus Index" at the University of KwaZulu-Natal's *Centre for Water Resources Research* on 25 April 2019, in Pietermaritzburg, South Africa,
- A workshop entitled the "Development of the Water-Energy-Food Nexus Index and its application to South Africa and the South African Development Community (SADC): From Theory to Practise" at the Water Research Commission in Pretoria, South Africa, on 10 May 2019,
- A presentation at the 2019 European Climate Change Adaptation Conference in Lisbon, Portugal, on 30 May 2019, entitled the "Development of the Water-Energy-Food Nexus Index and its application to South Africa and SADC",
- A lunchtime seminar at IHE Delft Institute for Water Education, Delft, The Netherlands on 5 June 2019, entitled the "Development of the Water-Energy-Food Nexus Index and its application to South Africa and SADC", and
- A COIN Open Day at the JRC in Ispra, Italy, on 7 June 2019, entitled the "Development of the Water-Energy-Food nexus index and its application to South Africa and SADC".

The outcome of this analysis and stakeholder/expert engagement was that a set of 21 indicators were selected to compose the WEF Nexus Index, which is presented in **Figure 3**. Adequate data is available for the index to be calculated for 170 nations. The untreated indicator data for the 21 indicators that make up the WEF Nexus Index are presented in **Addendum B**. The water-access sub-pillar represents SDG 6 (access to basic drinking water and sanitation services) and the degree of Integrated Water Resources Management (IWRM; which is an indicator of good governance in terms of water resources management).

The energy-access sub-pillar includes both access to electricity (SDG indicator 7.1.1) and two indicators that appertain to the degree of renewable energy consumption (SDG indicator 7.2.1) and implementation, as well as CO_2 emissions (which is an indicator of the degree of dependence on fossil fuels). These indicators have been aggregated because SDG 7 appertains to access to affordable, reliable, sustainable and modern energy for all, and not simply 'access to energy'.

The food-access sub-pillar includes, amongst others, SDG indicators 2.1.1 (prevalence of undernourishment), 2.2.1 (percentage of children under five years of age who are stunted) and FAO indicator 4.8 (prevalence of obesity in the adult population). The food-accessibility sub-pillar includes FAO indicators 1.1 (average dietary energy supply adequacy), 1.2 (average value of food production) and 1.4 (average protein supply), and the cereal yield in kilograms per hectare.

The latest available data (in August 2019) was utilised for the calculation of the WEF Nexus Index, with the reference year varying between indicators, as presented in **Appendix A**.

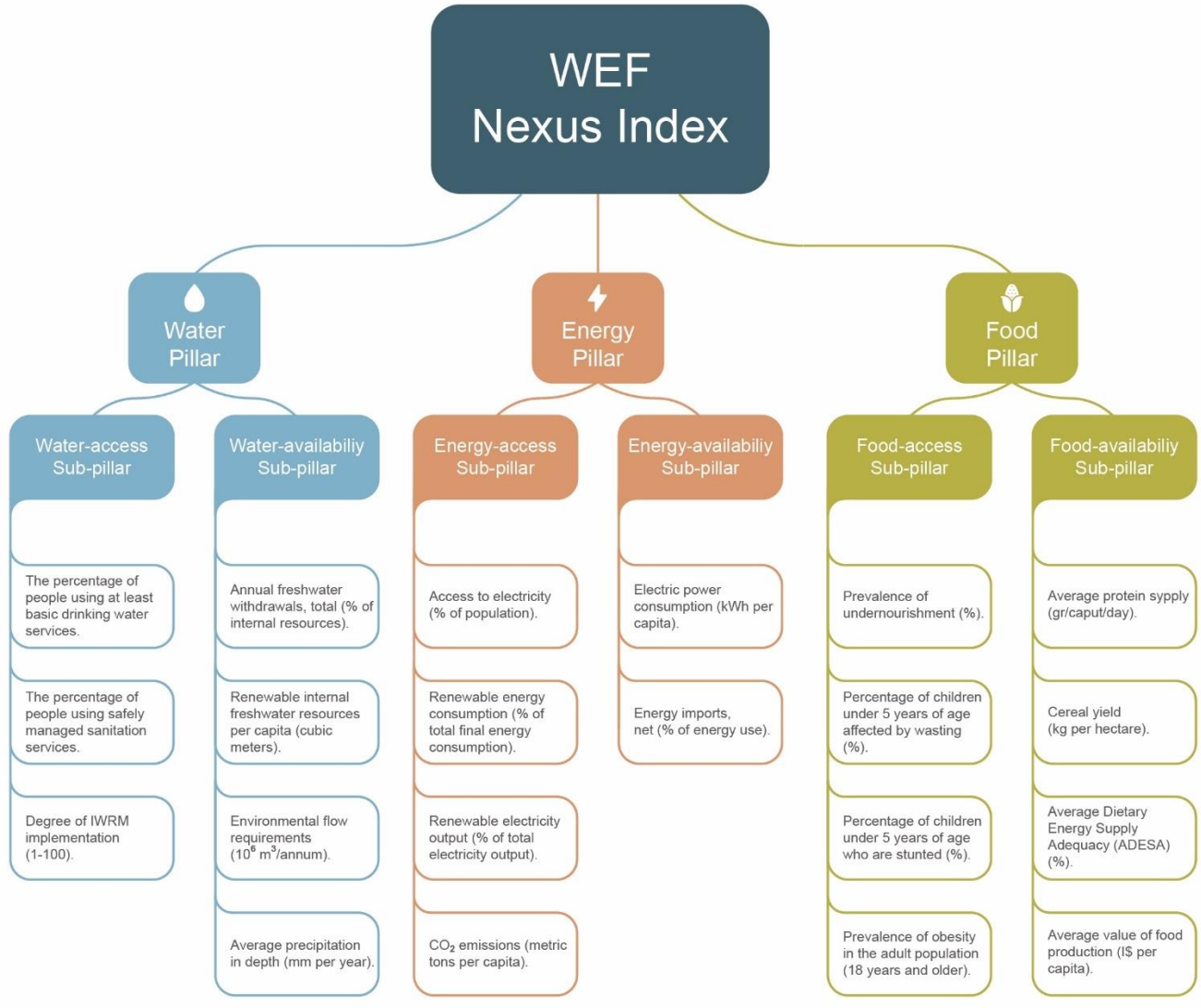

Figure 3: Schematic layout of the WEF Nexus Index, with its constituent pillars, sub-pillars, and indicators

3.4 Data treatment and normalisation

Following the selection of indicators, missing data were imputed where appropriate or necessary in accordance with the JRC:COIN guidelines. One case of imputation was for levels of undernourishment in high-income countries. Here, average values reported by UNICEF were utilised, e.g. the average prevalence of undernourishment in high-income countries is 1.2% (Sachs et al. 2018). All indicators were then normalised to transform them into a uniform scale: [0:100] (OECD 2008). This is standard practice in composite indicator construction, since not only are the indicators measured in different units, but their values vary markedly, e.g. the indicator *Percentage of children under five years of age who are affected by wasting* varies from 0.3% to 22.7%, whereas the *Renewable internal freshwater resources per capita* vary from 2.5 to 519 265 cubic metres. In this project, the min-max method was utilised to normalise the data (Saisana et al. 2018, Simpson et al. 2020). The COIN Tool was utilised for the calculation of the WEF Nexus Index (Becker et al. 2019).Where there was no data for an indicator, shallow imputation was applied by the COIN Tool, whereby it "calculates the sub-pillar score by taking the mean only over the indicators that have data" (Becker et al. 2019). This is the same as substituting the missing value with the normalised mean of the other indicators in the aggregation group (e.g. pillar or sub-pillar).

Outliers were treated in particular cases. This practice is necessary since outliers "generally spoil basic descriptive statistics such as the mean, the standard deviation, and correlation coefficient, thus causing misinterpretation" (Saisana et al. 2018). Where the skewness and kurtosis of an indicator's data set exceeded the generally accepted range, i.e. $|<2|$ and $|<3.5|$ respectively, a process of either Winsorisation (where there are five or fewer outliers) or a Box-cox transformation (if the number of outliers exceeds five) was adopted (Saisana et al. 2018). This is described in more detail in Simpson et al. (2020).

3.5 Weighting and aggregation of indicators

The sub-pillar scores were obtained by determining the weighted arithmetic average of the indicators in each sub-pillar. Pillar scores were calculated using the arithmetic average of the corresponding sub-pillar scores, and the final index score was an arithmetic average of the pillar scores. Equal weighting was used at the pillar level to preserve the multi-centric philosophy of the WEF nexus approach, such that each resource sector has equal importance (Allouche et al. 2015, Benson et al. 2015, Owen et al. 2018). Given that some sub-pillars contain more indicators than others and the fact that some indicators in a sub-pillar have stronger weightings than others, the final weight of each indicator in the overall index is unequal. The final weights, per aggregation level, are presented in **Table 1** and **Addendum C**.

The arithmetic mean was used for aggregation despite its known properties of compensability. Compensability refers to the extent to which a decrease in one indicator can be compensated for by an increase in another indicator. If the indicators are summed, i.e. using the arithmetic mean, there is a higher degree of compensability than if they are multiplied, i.e. using the geometric mean. This is because the latter method 'penalises' lower scores in indicators to a greater extent than the former method. The use of the arithmetic mean to calculate the WEF Nexus Index was, nonetheless, prefered because there is a reasonable degree of substitutability between SDGs and utilising the arithmetic mean is easier to understand than the geometric mean. This method of aggregation was also adopted in the development of the SDG Index (Sachs et al. 2016, Sachs et al. 2018).

3.6 Open science and visualisation

An essential part of this project is the communication of the WEF Nexus Index. Now, more than ever, visualising data in an engaging manner is vital for the acceptance and dissemination of public data, making it more accessible and understandable (Shneiderman 1996, van Wijk 2005). Data visualisation is the discipline that studies how to interpret and understand graphics and charts that represent complex data (Tufte 1983). Its primary design principles have been applied in a set of visualisations compiled in an interactive website associated with the WEF Nexus Index, namely https://www.wefnexusindex.org/.

The website, published to disseminate the WEF Nexus Index, provides data at hierarchical levels. First, it offers a global view of the main index, as well as its three main pillars (water, energy and food), utilising an interactive globe. The globe includes a novel legend that combines a classical colour legend with a strip plot, which graphically presents the distribution of the selected index or pillar.

At the same level of visualisation, and complementary to the globe, are visualisations comprising of glyphs (as presented in **Figure 4**). These glyphs represent the WEF Nexus Index and its pillars by country. These glyphs can be compared and sorted in order to facilitate a WEF nexus analysis. Further, each country has a dedicated page that provides more details for that nation such as the availability and access sub-pillar values, a radar chart, global rankings, a scatter plot of accessibility and access (which highlights correlations), together with the indicator values themselves.

4 Results

The WEF Nexus Index was calculated for 170 nations, as presented in the annotated world map in **Figure 4** (also refer to the visualisation website associated with the WEF Nexus Index https://www.wefnexusindex.org/). The treated values for these countries are presented in a dashboard in **Addendum D**. The highest- and lowest-twenty ranking countries for the WEF Nexus Index are shown in **Table 2** and **Table 3**, respectively. The median WEF Nexus Index value is 55, while the average is 54.

The five Scandinavian countries rank in the top ten (Norway, Sweden, Iceland, Denmark and Finland). These nations are characterised by high levels of service delivery in terms of improved drinking water services, safe sanitation facilities, and access to electricity. They also generally have high levels of renewable freshwater resources with low withdrawal levels, together with relatively high renewable energy output.

While the highest-twenty ranking nations are predominantly developed countries, there are five South American countries and one Asian state (Malaysia) within this list. The five South American countries in the top twenty are Brazil (tenth), Columbia (fourteenth), Paraguay (fifteenth), Argentina (nineteenth) and Uruguay (twentieth).

While no African countries feature in the twenty highest-ranking nations for the WEF Nexus Index, three-quarters of lowest-ranking countries are from Africa. These countries are, however, generally low emitters of CO_2 per capita, primarily due to the dearth of proven coal reserves outside of South Africa (Agora 2017), together with relatively low levels of development (although several African nations utilise oil or gas for electricity generation). Within the twenty lowest-ranking nations, Djibouti, Mauritania, Yemen, and South Sudan are from the Middle East and North Africa (MENA) region. The MENA region is characterised by severe water scarcity and a steady transition toward renewable energy (Hoff et al. 2019).

Table 1: Contribution of indicators, sub-pillars, and pillars to the WEF Nexus Index

Indicator	Indicator weight in the index	Sub-pillar	Sub-pillar weight in the index	Pillar	Pillar wieght in the index
1	0.056	Water-access	$\frac{1}{6}$	Water	$\frac{1}{3}$
2	0.056				
3	0.056				
4	0.042	Water-availability	$\frac{1}{6}$		
5	0.042				
6	0.042				
7	0.042				
8	0.083	Energy-access	$\frac{1}{6}$	Energy	$\frac{1}{3}$
9	0.028				
10	0.028				
11	0.028				
12	0.083	Energy-availability	$\frac{1}{6}$		
13	0.083				
14	0.056	Food-access	$\frac{1}{6}$	Food	$\frac{1}{3}$
15	0.028				
16	0.028				
17	0.056				
18	0.042	Food-availability	$\frac{1}{6}$		
19	0.042				
20	0.042				
21	0.042				

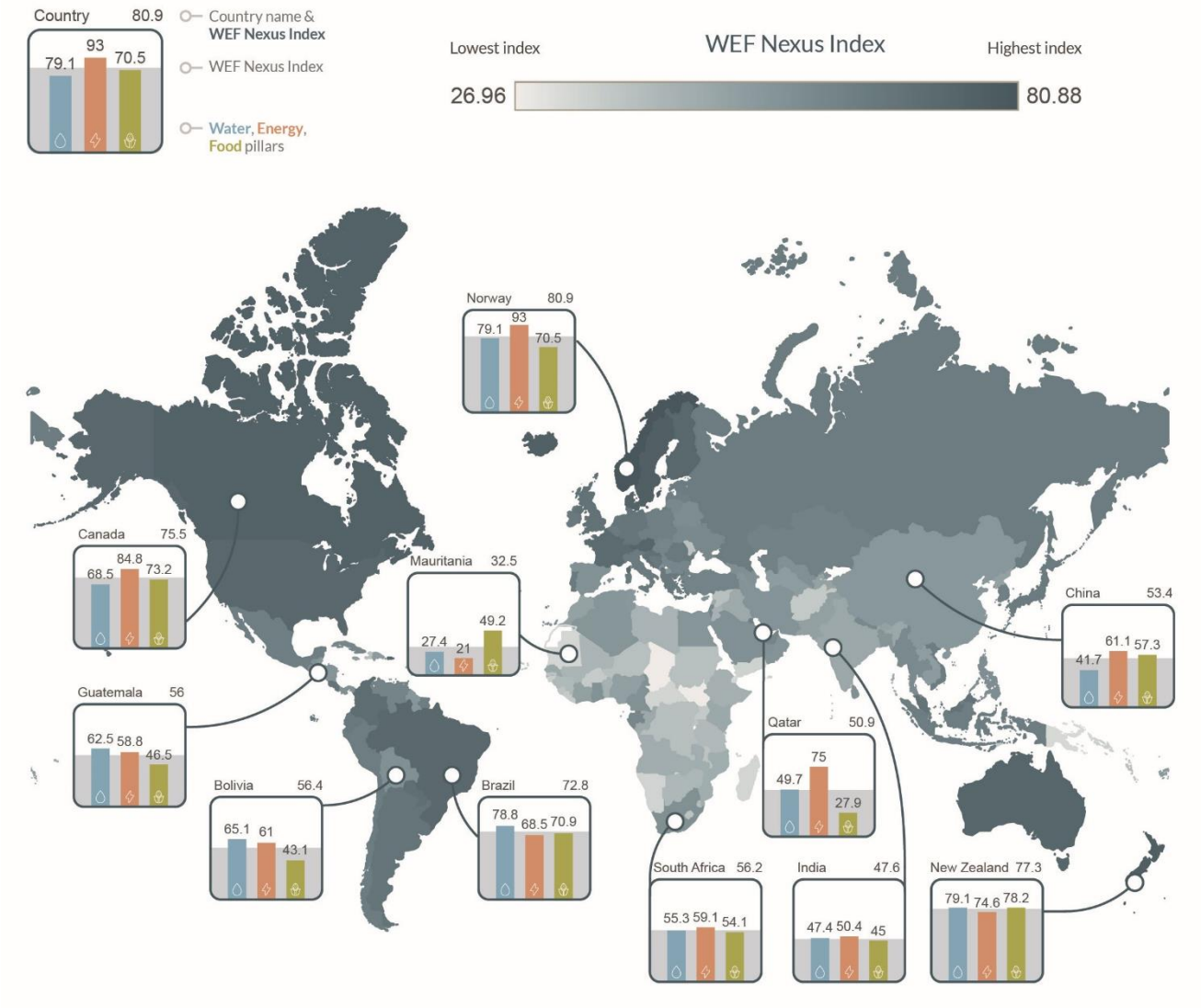

Figure 4: World map indicating the WEF Nexus Index per country (with selected countries featured in glyphs) – see https://www.wefnexusindex.org/ **for an interactive website**

Mauritania in north-western Africa, for example, has a mean annual precipitation (MAP) of only 92 mm (less than half of the 10th percentile value for the nations assessed). This nation's annual freshwater withdrawal is more than three times its total internal freshwater resources (337 % and 98.4 cubic metres per capita). The country with the lowest WEF Nexus Index value is the landlocked Central African nation of Chad, with a score of 27.0.

The results of this WEF nexus assessment highlight the stark inequalities in the world between countries that have excellent access to, and availability of, resources, and those that do not. Further, coal and oil have been utilised as a means to develop numerous nations. Many of the countries that have built their wealth on the back of fossil fuel-based energy generation are now steadily transitioning to being low-carbon developed economies.

Table 2: WEF Nexus Index values for the twenty highest-ranked countries

	WEF Nexus Index	Water sub-Index	Energy sub-Index	Food sub-Index
Norway	80.80	79.10	93.02	70.53
New Zealand	77.29	79.12	74.58	78.17
Sweden	76.87	78.18	82.33	70.11
Iceland	76.57	79.38	93.17	57.16
Canada	75.51	68.50	84.81	73.22
Denmark	75.32	70.64	73.53	81.80
Australia	74.10	78.55	70.89	72.87
Austria	74.06	77.85	62.64	81.69
Finland	72.83	74.16	75.97	68.35
Brazil	72.75	78.81	68.53	70.92
USA	72.67	65.40	73.33	79.28
France	71.74	77.73	59.24	78.24
Switzerland	71.19	77.01	63.67	72.88
Colombia	70.12	82.64	67.20	60.53
Paraguay	69.99	68.97	73.78	67.21
Croatia	68.96	78.48	59.70	68.69
United Kingdom	68.53	75.56	58.29	71.74
Malaysia	67.79	79.37	64.06	59.94
Argentina	67.63	67.60	61.41	73.87
Uruguay	67.52	65.93	63.74	72.89

Table 3: WEF Nexus Index values for the twenty lowest-ranked countries

	WEF Nexus Index	Water sub-Index	Energy sub-Index	Food sub-Index
Lesotho	37.93	43.68	26.52	43.60
Malawi	37.75	45.73	23.80	43.72
Rwanda	37.62	46.25	26.23	40.37
Uganda	36.27	40.51	28.69	39.61
Afghanistan	36.14	32.62	37.66	38.13
Timor-Leste	36.08	43.01	24.75	40.49
Liberia	36.03	50.40	18.57	39.10
Burkina Faso	35.74	39.55	18.36	49.32
Guinea-Bissau	35.18	42.49	17.45	45.61
Solomon Islands	35.05	36.59	24.63	43.92
Comoros	34.31	42.64	31.14	29.13
Yemen, Rep.	33.98	22.92	50.74	28.28
Namibia	33.39	32.27	38.66	29.24
Central African Republic	33.15	45.71	24.69	29.05
Madagascar	32.94	43.33	22.82	32.69
Mauritania	32.54	27.40	21.02	49.22
Djibouti	32.13	36.42	21.17	38.81
Papua New Guinea	32.00	49.04	19.36	27.61
South Sudan	26.97	37.17	36.79	6.95
Chad	6.96	29.94	16.10	34.84

5 Application of the WEF Nexus Index to South Africa

The WEF Nexus Index is a quantitative measure of resource security that relates to water, energy and food. It provides an entry point for the evaluation of the status of a nation in terms of integrated resource management. A WEF Nexus Index value is, therefore, an indication of a country's level of equitable access to, and availability of, these three critical resources. These assessments should be combined with other quantitative and qualitative research to broaden the analysis beyond the 'reach' of the constituent indicators (which is a limitation of a composite indicator), as presented in **Figure 1**.

To demonstrate how the WEF Nexus Index can be utilised as a catalyst and foundation for nexus analyses, it has been applied to a case study from the developing world, namely South Africa. This assessment demonstrates the value and relevance of the underlying pillars, sub-pillars and indicators. South Africa, with an index value of 56.2, ranked 72nd out of the 170 nations with sufficient data to calculate the WEF Nexus Index, as presented in **Figure 5** and **Table 4**. Of the 49 African nations in this study, South Africa ranked 2nd behind Gabon, which has an index value of 59.4. The water, energy, and food pillar values for South Africa are 55.3, 59.1 and 51.1, respectively.

While access to basic drinking water and safely managed sanitation services are relatively high, given South Africa's history of inequality in terms of service delivery, water availability is decidedly stressed (Mabhaudhi et al. 2018). Significant effort and focussed policies are, therefore, necessary to prudently manage South Africa's scarce water resources. Since the end of Apartheid, the levels of access to at least basic drinking water (87.4% in 2015) and safely managed sanitation services (73.1% in 2015) have increased significantly in South Africa (World Bank 2018). These values, together with the degree of IWRM implementation, at 65.5%, yield the highest sub-pillar value for this nation. Much work, however, remains in South Africa, mainly because it still exhibits extreme levels of income inequality, with one of the highest Gini coefficients globally (Hundenborn et al. 2019). This disparity is evidenced by 4% of the population in some provinces still utilising the “bucket toilet system”, while nationally 4% of the populace practice open defecation (StatsSA 2016).

The water-availability sub-pillar is, in contrast, the second-lowest for South Africa. This is partly due to this nation receiving approximately half the global mean annual rainfall (Pitman 2011, DWA 2016). South Africa yields less available freshwater per capita than nations that are generally considered to be significantly drier, such as Namibia and Botswana (DWA 2013). South Africa's renewable internal freshwater resources were 821 cubic metres per capita in 2014 (World Bank 2018), which is less than the 20th percentile for the 170 nations assessed.

In terms of annual freshwater withdrawals, South Africa extracted 34.6% of its internal resources in 2014 (World Bank 2018), which is marginally less than the 80th percentile for the countries included in this study. In this regard, Colvin et al. (2011) explain that "More than 95% of the usable water yield has been allocated for the ecological reserve, to meet international obligations and to supply water for domestic, industrial and agricultural use."

In terms of 'water for food', the elevated water stress and allocation levels severely limit opportunities for boosting food production through increasing irrigated agriculture. Land is also a constraint in this regard, with only 3% of South Africa's surface area being considered high potential arable land (Collett 2013). In terms of one facet of 'water for energy' (other aspects of this nexus will be discussed later in this article), South Africa has minimal hydropower potential and development (Conway et al. 2015).

While South Africa's increase in access to electricity since 1990 has been marked (World Bank 2018), with 84% of the population having access to electricity in 2016 (as opposed to 59.3% in 1990), the same cannot be said about the nation's transition to renewable energy. In contrast to the lack of coal reserves in other African countries, South Africa has 95% of the continent's proven coal reserves

(Agora 2017). It is the seventh-largest producer of coal internationally (International Energy Agency 2017). In 2014 it emitted nine tonnes of CO_2 per capita, and three years later was the fourteenth highest nett emitter of CO_2 globally (Fleming 2019).

In 2014, South Africa generated about 253 TWh of power, almost 92% of which was produced through burning coal (Agora 2017). Based on long-term contracts South Africa will probably continue to depend on coal-fired power stations for the next three to five decades (Delport et al. 2015). As a result, South Africa's renewable electricity output was only 2.3% of the total electricity output in 2015 (World Bank 2018).

Trade-offs associated with fossil-fuel-based energy security (and the associated coal mines) in South Africa include, *inter alia*, human health, air pollution, water pollution, loss of high-potential agricultural land and loss of biodiversity (Colvin et al. 2011, BFAP 2012, Lodewijks et al. 2013, CER 2016, Solomons 2016, CER 2018, Forrest and Loate 2018, Greenpeace 2018, CER 2019, Fleming 2019, Simpson et al. 2019). A crucial consideration in integrated resource management is that the attainment of resource security for one sector should not compromise an interdependent sector (Simpson and Berchner 2017). For national government, who must wear many 'hats', they are often 'between a rock and a hard place', This is because there are conflicting trade-offs associated with an accelerated transition to a low-carbon economy. These include sector-related jobs (as well as secondary and tertiary employment spawned by the coal and power industries) and export revenue (Delport et al. 2015, Webb 2015, Simpson et al. 2019).

In terms of 'water for energy' power generation utilises approximately 2% of the available freshwater in the country (DWA 2013). Eskom, the state-owned utility stands at the front of the ‘queue' in terms of water allocation. This is because it is guaranteed supply as the only ‘strategic’ water user under the National Water Act 36 of 1998 (Olsson 2013). Not only does the power-generation industry require water at the highest level of assurance, but it also requires excellent water quality (WWF 2011). In terms of 'energy for food' and 'energy for water', electricity supply to the national grid has been interrupted by 'load shedding' (rolling blackouts) at regular intervals over the last twelve years, which has had a significant negative impact on the economy (World Bank 2017).

The energy-accessibility sub-pillar includes two indicators, i.e. electric power consumption and nett energy imports. In terms of the first of these, South Africa's populace consumed 4198 kWh per capita in 2014 (World Bank 2018). This value is less than the 67th percentile for the 170 nations assessed. For the same base year, South Africa was a nett exporter of energy.

The second-highest-ranking sub-pillar for South Africa is the food access sub-pillar. The prevalence of undernourishment in South Africa is 6.1%, which is below the median value for the countries included in this study, i.e. 6.5% (World Bank 2018). While the percentage of children under five years of age who are affected by wasting is 2.5% (slightly less than the 40th percentile), 27.4% are stunted, i.e. marginally less than the 70th percentile value. Meanwhile, the prevalence of obesity in the adult population, eighteen years or older, is 27%, which exceeds the 80th percentile. These values emphasise the profound inequalities that exist among South Africa's citizens.

Maize is South Africa's major grain crop, providing the staple diet for the bulk of the population. About half of the maize produced is used for animal feed, 70% of which is for poultry (WWF 2010, BFAP 2018). Traditionally, South Africa was a nett exporter of food, but it has recently become a nett importer due to agricultural production not increasing at the same rate as population growth (Bazilian et al. 2011). Food production could be further jeopardised by the loss of high potential agricultural land due to mining and urbanisation, particularly in the province of Mpumalanga (Simpson et al. 2019).

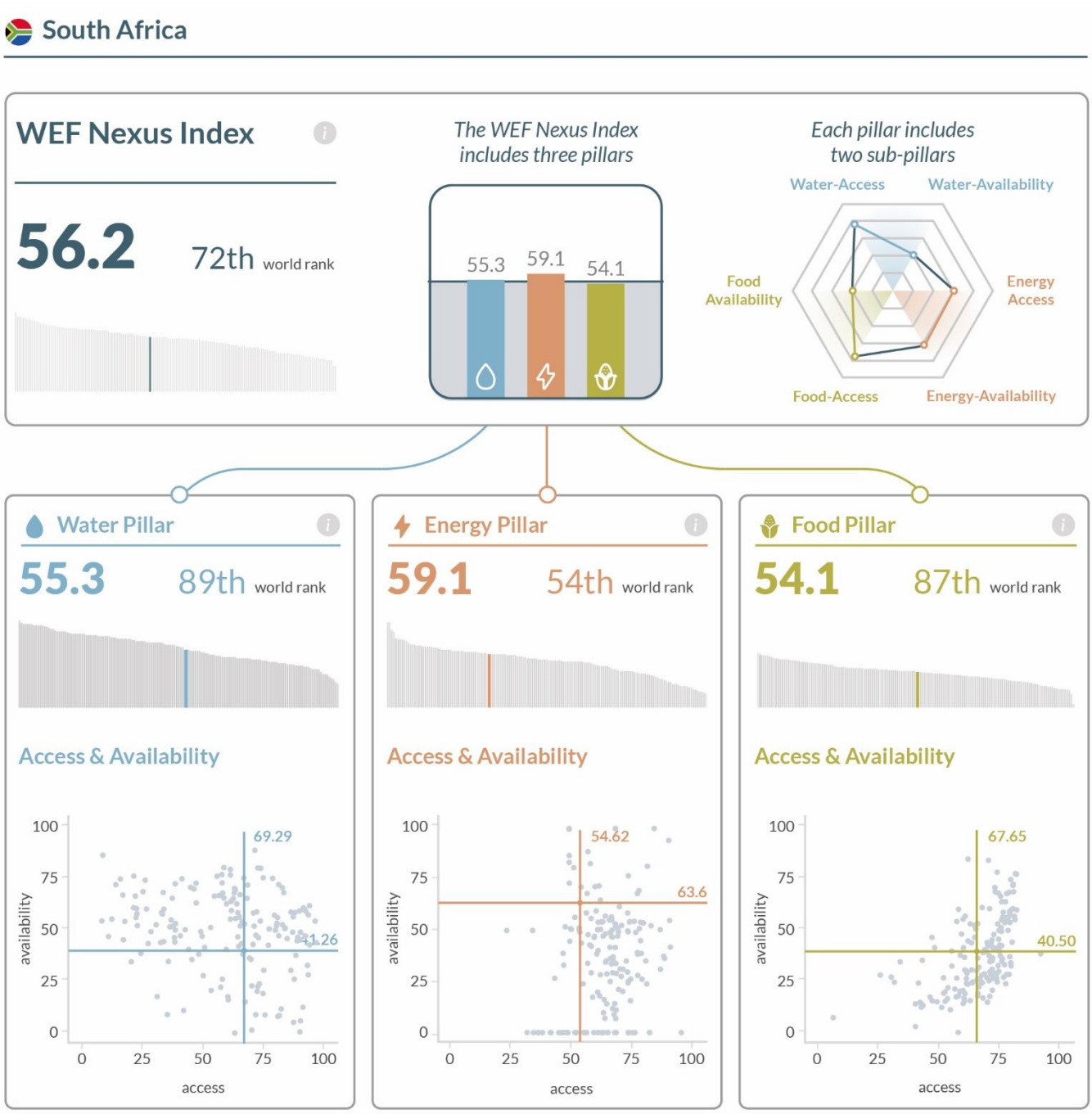

Figure 5: Country data for case study nation, South Africa, indicating WEF Nexus Index, pillar, sub-pillar values and ranking

Alarmingly, the lowest ranking sub-pillar is the food-availability sub-pillar, with a value of 40.5. Three of the constituent indicators, namely average protein supply, average dietary energy supply adequacy and the average value of food production, have values that approximate the median value for the nations included in this study. The cereal yield, at 3810 kilograms per capita per hectare (World Bank 2018), exceeds the 60th percentile value for the 170 countries included in this study. The low sub-pillar value, together with the relatively average rank of South Africa in terms of the availability of food, indicates that this is an issue of global concern. This conclusion is confirmed by the FAO (2018), who state that

"Feeding a global population that is expected to reach 9.8 billion people by 2050 will require a 60 per cent increase in food production (compared with 2012 levels) and substantial avoidance of food losses along value chains."

Table 4: Indicators (and values) that constitute the WEF Nexus Index

Indicator values		
	Access	
01	The percentage of people using at least basic drinking water services.	84.7
02	Percentage of people using safely managed sanitation services.	73.1
03	Degree of IWRM implementation (1-100).	65.5
	Availability	
04	Annual freshwater withdrawals, total (% of internal resources).	34.6
05	Renewable internal freshwater resources per capita (cubic meters).	821.4
06	Environmental flow requirements (106 m3/annum).	20.1
07	Average precipitation in depth (mm per year).	495.0

Indicator values		
	Access	
08	Access to electricity (% of population).	84
09	Renewable energy consumption (% of total final energy consumption).	17
10	Renewable electricity output (% of total electricity output).	2
11	CO2 emissions (metric tons per capita).	9
12	**Availability**	
13	Electric power consumption (kWh per capita).	4,198
	Energy imports, net (% of energy use).	-14

Indicator values		
	Access	
14	Prevalence of undernourishment (%).	6
15	Percentage of children under 5 years of age affected by wasting (%).	3
16 17	Percentage of children under 5 years of age who are stunted (%).	27
	Prevalence of obesity in the adult population (18 years and older).	27
18	**Availability**	
19	Average protein supply (gr/caput/day).	83
20	Cereal yield (kg per hectare).	3,810
21	Average Dietary Energy Supply Adequacy (ADESA) (%).	123
	Average value of food production (I$ per capita).	229

6 Conclusions

This study has yielded a country-level composite indicator related to the WEF nexus that highlights water-, energy- and food-related issues. It provides a quantitative means of ascertaining 170 different nation's status in terms of integrated resource management, utilising the WEF nexus as a lens. It also provides an opportunity for comparing a nation's status with other countries, whether from the same region (e.g. SADC or MENA), at a similar level (i.e. developed or developing), or by assessing a nation relative to a specific country included in the study (high or low ranking). By providing a quantitative measure of the WEF nexus, the index provides a summary and entry point to the complex dataset that underlies it (refer to **Figure 1**). A more detailed analysis of the constituent indicators will provide the researcher, policy-maker or decision-maker with insights and prompts in terms of where interventions and investments are necessary. Based on the constituent indicators, the WEF Nexus Index is a function of the national resource base (e.g. land, water and fossil fuels), governance and service delivery, and the degree of energy transition (to renewable sources), consumption and self-sufficiency.

WEF nexus assessments in the decade leading up to the 2030 SDG target year must be more comprehensive. Qualitative studies should be conducted in parallel with quantitative assessments. There is no one-size-fits-all method for integrated resource management utilising the WEF nexus approach. Instead, the methodology must be tailored for each unique situation, and the WEF Nexus Index can be a catalyst and entry-point for such studies, as demonstrated through the application of the index to South Africa. By evaluating a subset/nexus of the SDGs, the index is complementary to the

SDGs. But as with the SDGs, this nexus study suffers from a shortage of 'integrated' indicators. This gap could be addressed in the future as new indicators are developed. The WEF Nexus Index is not a 'silver bullet' that will solve all the significant development and environmental challenges facing humanity. This approach can, however, be added to the sustainability toolbox that is being utilised to engineer 'the future we want'.

7 References

Abdullaev, I., and Rakhmatullaev, S. 2016. Setting up the agenda for water reforms in Central Asia: Does the nexus approach help? *Environmental Earth Sciences* 75. doi: 10.1007/s12665-016-5409-8

Abeyasekera, S. 2003. Multivariate methods for index construction. *Household Surveys in Developing and Transition Countries: Design, Implementation and Analysis*.

Agora. 2017. *Flexibility in thermal power plants - With a focus on existing coal-fired power plants*. Agora Energiewende, Berlin, Germany. Report number: 115/04-S-2017/EN www.agora-energiewende.de

Albrecht, T. R., Crootof, A., and A., S. C. 2018. The Water-Energy-Food Nexus: A systematic review of methods for nexus assessment. *Environmental Research Letters* 13. doi: 10.1088/1748-9326/aaa9c6

Allouche, J., Middleton, C., and Gyawali, D. 2015. Technical Veil, Hidden Politics: Interrogating the Power Linkages behind the Nexus. *Water Alternatives-an Interdisciplinary Journal on Water Politics and Development* 8:610-626.

Allouche, J., Middleton, C., and Gyawali, D. 2019. *The Water-Energy-Food Nexus: Power, Politics, and Justice*. Routledge, Abingdon, Oxon.

Bazilian, M., Rogner, H., Howells, M., Hermann, S., Arent, D., Gielen, D., Steduto, P., Mueller, A., Komor, P., Tol, R. S. J., and Yumkella, K. K. 2011. Considering the energy, water and food nexus: Towards an integrated modelling approach. *Energy Policy* 39:7896-7906. doi: 10.1016/j.enpol.2011.09.039

Becker, W., Benavente, D., Dominguez Torreiro, M., Moura, C., Neves, A., Saisana, M., and Vertesy, D. 2019. *COIN Tool User Guide*. Publications Office of the European Union, Luxembourg.

Beddington, J. 2009. *Food, energy, water and the climate: A perfect storm of global events?* , Government Office for Science, London, England.

Beddington, J. 2010. Food security: contributions from science to a new and greener revolution. *Philosophical Transactions of the Royal Society* B:61-71. 10.1098/rstb.2009.0201

Belinskij, A. 2015. Water-Energy-Food Nexus within the Framework of International Water Law. *Water* 7:5396-5415. doi: 10.3390/w7105396

Benson, D., Gain, A. K., Rouillard, J., and Giupponi, C. 2017. Governing for the Nexus. Pages 77-88 Water-Energy-Food Nexus. John Wiley & Sons, Inc.

Benson, D., Gain, A. K., and Rouillard, J. J. 2015. Water Governance in a Comparative Perspective: From IWRM to a 'Nexus' Approach? *Water Alternatives-an Interdisciplinary Journal on Water Politics and Development* 8:756-773.

BFAP. 2012. *Evaluating the Impact of Coal Mining on Agriculture in the Delmas, Ogies and Leandra Districts: A Focus on Maize Production*. Bureau for Food and Agricultural Policy, Pretoria, South Africa. http://www.bfap.co.za

BFAP. 2018. *BFAP Baseline Agricultural outlook 2018-2027*.

Brouwer, F., Anzaldi, G., Laspidou, C., Munaretto, C., Schmidt, G., Strosser, P., Sušnik, J., and Vamvakeridou-Lyroudia, L. 2018. *Commentary To SEI Report 'Where is the added value? A review of the Water-Energy-Food Nexus Literature'*. SIM4NEXUS, Wageningen, Netherlands.

Cairns, R., and Krzywoszynska, A. 2016. Anatomy of a buzzword: The emergence of 'the water-energy-food nexus' in UK natural resource debates. *Environmental Science & Policy* 64:164-170. doi: 10.1016/j.envsci.2016.07.007

CER. 2016. *ZERO HOUR: Poor Governance of Mining and the Violation of Environmental Rights in Mpumalanga*. Centre for Environmental Rights, Cape Town, South Africa. www.cer.org.za

CER. 2018. Water costs, impacts of coal-fired power grossly underestimated in electricity planning. Centre for Environmental Rights.

CER. 2019. *The Truth about Mpumalanga Coal Mines Failure to Comply with their Water Use Licences*.

Collett, A. 2013. The impact of effective (geo-spatial) planning on the agricultural sector. *South African Surveying and Geomatics Indaba 22-24 July 2013*.

Colvin, C., Burns, A., Schachtschneider, K., Maherry, A., Charmier, J., and de Wit, M. 2011. Coal and Water Futures in South Africa The case for protecting headwaters in the Enkangala grasslands. WWF-South Africa:82.

Conway, D., van Garderen, E. A., Deryng, D., Dorling, S., Krueger, T., Landman, W., Lankford, B., Lebek, K., Osborn, T., Ringler, C., Thurlow, J., Zhu, T. J., and Dalin, C. 2015. Climate and southern Africa's water-energy-food nexus. *Nature Climate Change* 5:837-846. doi: 10.1038/nclimate2735

De Laurentiis, V., Hunt, D. V. L., and Rogers, C. D. F. 2016. Overcoming Food Security Challenges within an Energy/Water/Food Nexus (EWFN) Approach. *Sustainability* 8. doi: 10.3390/su8010095

de Loë, R. C., and Patterson, J. J. 2017. Rethinking Water Governance: Moving Beyond Water-Centric Perspectives in a Connected and Changing World. *Natural Resources Journal* 57:75-99.

de Vito, R., Portoghese, I., Pagano, A., Fratino, U., and Vurro, M. 2017. An index-based approach for the sustainability assessment of irrigation practice based on the water-energy-food nexus framework. *Advances in Water Resources* 110:423-436. https://doi.org/10.1016/j.advwatres.2017.10.027

Delport, M., Davenport , M., van der Burgh, G., Meyer, F., Vink, N., Vermeulen, N., Davids, T., Blignaut, J., van der Walt, S., Truter, W., Pienaar, M., Solomon, M. H., Ottermann, A., and Blecher, G. 2015. *The Balance of Natural Resources: Understanding the Long Term Impact of Mining on Food Security in South Africa*. Bureau for Food and Agricultural Policy, Pretoria, South Africa.

DWA. 2013. National Water Resources Strategy: Water for an Equitable and Sustainable Future. Department of Water Affairs.

Esty, D. C., Levy, M. A., Srebotnjak, T., and de Sherbinin, A. 2005. *2005 Environmental Sustainability Index: Benchmarking National Environmental Stewardship*. Yale Center for Environmental Law & Policy, New Haven, Connecticut.

FAO. 2018. *Water-Energy-Food Nexus for the Review of SDG 7*. Food and Agriculture Organization.

Fleming, S. 2019. *Chart of the day: These countries create most of the world's CO2 emissions*. url: https://www.weforum.org/agenda/2019/06/chart-of-the-day-these-countries-create-most-of-the-world-s-co2-emissions/. World Economic Forum, Date accessed: 17 Jun 2019.

Forrest, K., and Loate, L. 2018. Power and Accumulation Coal Mining, Water and Regulatory Failure. *The Extractive Industries and Society* 5:154-164.

Galaitsi, S., Veysey, J., and Huber-Lee, A. 2018. *Where is the added value? A review of the water-energy-food nexus literature*. Stockholm Environmental Institute, Massachusetts.

Gallagher, L., Dalton, J., Bréthaut, C., Allan, T., Bellfield, H., Crilly, D., Cross, K., Gyawali, D., Klein, D., Laine, S., LeFlaive, X., Li, L., Lipponen, A., Matthews, N., Orr, S., Pittock, J., Ringler, C., Smith, M., Tickner, D., von Schlippenbach, U., and Vuille, F. 2016. The critical role of risk in setting directions for water, food and energy policy and research. *Current Opinion in Environmental Sustainability* 23:12-16. doi: 10.1016/j.cosust.2016.10.002

Greenpeace. 2018. *New satellite data reveals the world's largest air pollution hotspot is Mpumalanga - South Africa*. url: http://www.greenpeace.org/africa/.

Hoff, H. 2011. *Understanding the Nexus. Background Paper for the Bonn2011 Conference: The Water, Energy and Food Security Nexus.* Stockholm Environment Institute, Stockholm.

Hoff, H., Alrahaife, S. A., El Hajj, R., Lohr, K., Mengoub, F. E., Farajalla, N., Fritzsche, K., Jobbins, G., Özerol, G., Schultz, R., and Ulrich, A. 2019. A Nexus Approach for the MENA Region - From Concept to Knowledge to Action. *Frontiers in Environmental Science* 7. doi: 10.3389/fenvs.2019.00048

Hundenborn, J., Woolard, I., and Jellema, J. 2019. The effect of top incomes on inequality in South Africa. . *International Tax and Public Finance* 26:1018–1047. doi: 10.1007/s10797-018-9529-9

International Energy Agency. 2017. *Coal information: Overview statistics*. International Energy Agency. https://webstore.iea.org/coal-information-2017-overview

Jha, R., and Murthy, K. V. B. 2003. A Critique of the Environmental Sustainability Index. *Australian National University Division of Economics Working Paper*.

Liu, J., Yang, H., Cudennec, C., Gain, A. K., Hoff, H., Lawford, R., Qi, J., de Strasser, L., Yillia, P. T., and Zheng, C. 2017. Challenges in operationalizing the water-energy-food nexus. *Hydrological Sciences Journal-Journal Des Sciences Hydrologiques* 62:1714-1720. 10.1080/02626667.2017.1353695

Lodewijks, H., Beukes, J., Oberholster, P., Hill, L., Dabrowski, J., Wessels, P., and Cogho, V. 2013. *Risk Assessment of Pollution in Surface Waters of the Upper Olifants River System: Implications for Aquatic Ecosystem Health and the Health of Human Users of Water - Summary Report: 2009 - 2013*. Olifants River Forum, Mpumalanga, South Africa.

Mabhaudhi, T., Simpson, G. B., Badenhorst, J., Mohammed, M., Motongera, T., Senzanje, A., and Jewitt, G. 2018. *Assessing the State of the Water-Energy-Food (WEF) Nexus in South Africa*. Water Research Commission, Pretoria, South Africa.

McGrane, S. J., Acuto, M., Artioli, M., Chen, P.-Y., Comber, R., Cottee, J., Farr-Wharton, G., Green, N., Helfgott, A., Larcom, S., McCann, J. A., O'Reilly, P., Salmoral, G., Scott, M., Todman, L. C., van Gevelt, T., and Yan, X. 2018. Scaling the nexus: Towards integrated frameworks for analysing water, energy and food. *The Geographical Journal*:1-13. DOI: 10.1111/geoj.12256

Meadows, D. H., Meadows, D. L., Randers, J., and Behrens III, W. W. 1972. *The Limits to Growth*. Universe Books, New York.

Mohtar, R. H., and Daher, B. 2012. *Water, Energy, and Food: The Ultimate Nexus*. Second Edition edition. Taylor & Francis.

Muller, M. 2015. The 'Nexus' As a Step Back towards a More Coherent Water Resource Management Paradigm. *Water Alternatives-an Interdisciplinary Journal on Water Politics and Development* 8:675-694.

National Intelligence Council. 2012. *Global Trends 2030: Alternative Worlds*. National Intelligence Council, USA.

OECD. 2008. *Handbook on Constructing Composite Indicators: Methodology and User Guide*. Organisation for Economic Co-operation and Development.

Olsson, G. 2013. Water, energy and food interactions: Challenges and opportunities. *Frontiers of Environmental Science & Engineering* 7:787-793. doi: 10.1007/s11783-013-0526-z

Owen, A., Scott, K., and Barrett, J. 2018. Identifying critical supply chains and final products: An input-output approach to exploring the energy-water-food nexus. *Applied Energy* 210:632-642. 10.1016/j.apenergy.2017.09.069

Ringler, C., Bhaduri, A., and Lawford, R. 2013. The nexus across water, energy, land and food (WELF): potential for improved resource use efficiency? *Current Opinion in Environmental Sustainability* 5:617-624. doi: 10.1016/j.cosust.2013.11.002

Rockstrom, J., Steffen, W., Noone, K., Persson, A., F. S. Chapin, I., Lambin, E., Lenton, T. M., Scheffer, M., Folke, C., Schellnhuber, H., Nykvist, B., Wit, C. A. D., Hughes, T., Leeuw, S. v. d., Rodhe, H., Sorlin, S., Snyder, P. K., Costanza, R., Svedin, U., Falkenmark, M., Karlberg, L., Corell, R. W., Fabry, V. J., Hansen, J., Walker, B., Liverman, D., Richardson, K., Crutzen, P., and Foley, J. 2009. Planetary Boundaries: Exploring the Safe Operating Space for Humanity. *Ecology and Society* 14:32.

Sachs, J., Schmidt-Traub, G., Kroll, C., Durand-Delacre, D., and Teksoz, K. 2016. SDG Index & Dashboards - Global Report. New York: Bertelsmann Stiftung and Sustainable Development Solutions Network (SDSN).

Sachs, J., Schmidt-Traub, G., Kroll, C., Lafortune, G., and Fuller, G. 2018. *SDG Index and Dashboards Report 2018: Global Responsibilities - Implementing The Goals*. Bertelsmann Stiftung and Sustainable Development Solutions Network.

Sachs, J., Schmidt-Traub, G., Kroll, C., Lafortune, G., and Fuller, G. 2019. *Sustainable Development Report 2019*. New York.

Saisana, M., Alberti, V., Alvarez, M., Becker, W., Caperna, G., Cocco, C., Damioli, G., De Pedraza, P., Del Sorbo, M., D'Hombres, B., Dominguez-Torreiro, M., Montalto, V., Moura, C., Neves, A., Norlen, H., Panella, F., Papadimitriou, E., and Vertesy, D. 2018. 16th JRC Annual Training on Composite Indicators and Scoreboards. Joint Research Centre: Competence Centre on Composite Indicators and Scoreboards, Ispra, Italy.

Salam, P. A., Pandey, V. P., Shrestha, S., and Anal, A. K. 2017. The Need for the Nexus Approach. Pages 1-10 Water-Energy-Food Nexus: Principles and Practices. John Wiley & Sons, Inc.

Segnestam, L. 2002. Indicators of Environment and Sustainable Development: Theories and Practical Experience. The World Bank Environment Department.

Shneiderman, B. 1996. The Eyes Have It: A Task by Data Type Taxonomy for Information Visualizations. *Proceedings 1996 IEEE Symposium on Visual Languages*. doi: 10.1109/VL.1996.545307

Simpson, G., and Berchner, M. 2017. Measuring integration – towards a water-energy-food nexus index. *The Water Wheel*:22-23.

Simpson, G. B., Badenhorst, J., Berchner, M., Jewitt, G. P. W., and Davies, E. 2019. Competition for Land: The Water-Energy-Food Nexus and Coal Mining in Mpumalanga Province, South Africa. *Frontiers in Environmental Science* 7:1-12. doi: 10.3389/fenvs.2019.00086

Simpson, G. B., and Jewitt, G. P. W. 2019a. The Development of the Water-Energy-Food Nexus as a Framework for Achieving Resource Security: A Review. *Frontiers in Environmental Science* 7:1-9. 10.3389/fenvs.2019.00008

Simpson, G. B., and Jewitt, G. P. W. 2019b. The water-energy-food nexus in the anthropocene: Moving from 'nexus thinking' to 'nexus action'. *Current Opinion in Environmental Sustainability* 40:117-123. doi: 10.1016/j.cosust.2019.10.007

Simpson, G. B., Jewitt, G. P. W., and Badenhorst, J. 2020. *The Water-Energy-Food Nexus Index and its application to South Africa and the Southern African Development Community*. WRC Report no. 2959/1/19, Water Research Commission, Pretoria. ISBN No 978-0-6392-0113-9 http://wrcwebsite.azurewebsites.net/wp-content/uploads/mdocs/2959_final.pdf

Solomons, I. 2016. Mpumalanga paying huge enviro price owing to poor regulation by govt departments – report. Mining Weekly.

StatsSA. 2016. Water and Sanitation: In-depth analysis of the General Household Survey 2002–2015 and Community Survey 2016 data. Statistics South Africa: GHS Series Volume VIII:106.

Steffen, W., Rockstrom, J., Richardson, K., Lenton, T. M., Folke, C., Liverman, D., Summerhayes, C. P., Barnosky, A. D., Cornell, S. E., Crucifix, M., Donges, J. F., Fetzer, I., Lade, S. J., Scheffer, M., Winkelmann, R., and Schellnhuber, H. J. 2018. Trajectories of the Earth System in the Anthropocene. *Proceedings of the National Academy of Sciences of the United States of America* 115:8252-8259. 10.1073/pnas.1810141115

Sullivan, C. 2002. Calculating a Water Poverty Index. *World Development* 30:1195–1210.

Sušnik, J. 2018. Data-driven quantification of the global water-energy-food system. *Resources, Conservation & Recycling* 133:179–190. doi: 10.1016/j.resconrec.2018.02.023

Transparency International. 2018. *Corruption Perceptions Index 2018*. url: https://www.transparency.org/cpi2018, Date accessed: 20 September 2019.

Tufte, E. 1983. *The Visual Display of Quantitative Information*. Graphics Press.

UN Water. 2018. *Sustainable Development Goal 6: Synthesis Report on Water and Sanitation*. United Nations, New York, USA.

van Wijk, J. 2005. The Value of Visualization. . *IEEE Visualization* 5. doi: 10.1109/VISUAL.2005.1532781

Waas, T., Hugé, J., Block, T., Wright, T., Benitez-Capistros, F., and Verbruggen, A. 2014. Sustainability Assessment and Indicators: Tools in a Decision-Making Strategy for Sustainable Development. *Sustainability* 6:5512-5534. 10.3390/su6095512

Webb, M. 2015. Coal 2015: A review of South Africa's Coal Sector. Creamer Media.

Weitz, N., Strambo, C., Kemp-Benedict, E., and Nilsson, M. 2017. Closing the governance gaps in the water-energy-food nexus: Insights from integrative governance. *Global Environmental Change-Human and Policy Dimensions* 45:165-173. 10.1016/j.gloenvcha.2017.06.006

Wendling, Z. A., Emerson, J. W., Esty, D. C., Levy, M. A., and de Sherbinin, A. 2018. *2018 Environmental Performance Index. New Haven, CT*. New Haven, Connecticut.

Wichelns, D. 2017. The water-energy-food nexus: Is the increasing attention warranted, from either a research or policy perspective? *Environmental Science & Policy* 69:113-123. doi: 10.1016/j.envsci.2016.12.018

Wong, J. L. 2010. The Food-Energy-Water Nexus. *Harvard Asia Quarterly* 12:15-19.

World Bank. 2017. *Modeling the Water-Energy Nexus: How Do Water Constraints Affect Energy Planning in South Africa?* World Bank Group.

World Bank. 2018. *Indicators. Data*. url: http://data.worldbank.org/indicator/, Date accessed: 1 March

World Economic Forum. 2011. *Water Security: The Water-Energy-Food-Climate Nexus*. World Economic Forum, Washington, USA.

World Economic Forum. 2018. *The Global Risks Report 2018 - 13th Edition*. World Economic Forum, Geneva.

WWF. 2010. *Agriculture: Facts & Trends South Africa*.

WWF. 2011. Coal and Water Futures in South Africa: A case for conserving headwaters in Enkangala Grasslands. Media Backgrounder:1-14.

WWF and SABMiller. 2014. The Water-Food-Energy Nexus: Insights into Resilient Development.20.

8 Conflict of Interest

Gareth Simpson and Jessica Badenhorst are employed by the company Jones & Wagener (Pty) Ltd. Pere Rovira and Victor Pascual are employed by the company OneTandem. All other authors declare no competing interests.

9 Author Contributions

Gareth Simpson wrote the manuscript in consultation with Professor Graham Jewitt, who supervised the project. William Becker and Ana Neves provided input into the development of the WEF Nexus Index. William Becker contributed to the final manuscript. Jessica Badenhorst assisted with the selection of indicators and in the literature review of the WEF nexus in South Africa. Pere Rovira and Victor Pascual developed the data visualisations and described the philosophy and importance of visualisation in this study.

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Addendum A: WEF Nexus Index - Indicator selection table

No.	Sector	Indicator	Definition[1]	Source	Units	Data availability	SDG Indicator? (Y/N)	Reason/motivation for inclusion/exclusion
1	Water (SDG 6)	The percentage of people using at least basic drinking water services	This indicator encompasses both people using basic water services as well as those using safely managed water services. Basic drinking water services are defined as drinking water from an improved source, provided collection time is not more than 30 minutes for a round trip. Improved water sources include piped water, boreholes or tube wells, protected dug wells, protected springs, and packaged or delivered water (*FAO.org 2018, Accessed 2019-03-01*).	http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk **Source:** World Bank: http://data.worldbank.org/indicator/SH.H2O.BASW.ZS. **Original source:** WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply, Sanitation and Hygiene (washdata.org). Accessed 2019-03-01	%	2015 Very good data coverage. The indicator is utilised in SDG Index for SDG 6	No, but 6.1.1 (Proportion of population using safely managed drinking water services) and 6.3.2 are SDG indices. It is FAO indicator I_4.1	**Yes**; very good data, and the indicator is relevant to SDG 6. Alternative to official indicator 6.1.1 since it has better data coverage for many nations
2	Water (SDG 6)	People using safely managed drinking water services	The percentage of the population using drinking water from an improved water source which is located on premises, available when needed and free from faecal and priority chemical contamination (*FAO.org 2018, Accessed 2019-03-01*)	http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk **Source:** World Bank: http://data.worldbank.org/indicator/SH.H2O.SMDW.ZS **Original source:** World Health Organization and United Nations Children's Fund, Joint Measurement Programme (JMP) (http://www.wssinfo.org/). Accessed 2019-03-01	%	2015 Data coverage relatively sparse	Yes, 6.1.1. It is FAO indicator I_4.2	No; rather use "The percentage of people using at least basic drinking water services" as equivalent indicator since it has better data coverage
3	Water (SDG 6)	Percentage of people using at least basic sanitation services.	The percentage of people using at least basic sanitation services, that is, improved sanitation facilities that are not shared with other households. This indicator encompasses both people using basic sanitation services as well as those using safely managed sanitation services. Improved sanitation facilities include flush/pour flush to piped sewer systems, septic tanks or pit latrines; ventilated improved pit latrines, compositing toilets or pit latrines with slabs (*FAO.org 2018, Accessed 2019-03-01*).	http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk **Source:** World Development Indicators: World Bank: http://data.worldbank.org/indicator/SH.STA.BASS.ZS. **Original source:** World Health Organization and United Nations Children's Fund, Joint Measurement Programme (JMP) (http://www.wssinfo.org/). Accessed 2019-03-01	%	2015 Very good data coverage. The indicator is utilised in SDG Index for SDG 6	No, but 6.2.1 and 6.3.1 are SDG indices. It is FAO indicator I_4.3	No; very good data, and the indicator is relevant to SDG 6, but "Percentage of people using safely managed sanitation services" is an official SDG indicator, 6.2.1, and FAO lists the exact same data for the two.
4	Water (SDG 6)	Percentage of people using safely managed sanitation services.	The percentage of the population using improved sanitation facilities which are not shared with other households and where excreta are safely disposed in situ or transported and treated off-site (*FAO.org 2018, Accessed 2019-03-01*).	http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk **Source:** World Development Indicators: World Bank: http://data.worldbank.org/indicator/SH.STA.SMSS.ZS. **Original source:** World Health Organization and United Nations Children's Fund, Joint Measurement Programme (JMP)	%	2015 Very good data coverage. Data is identical to "Percentage of people using at least basic sanitation services."	Yes, 6.2.1 and it is FAO indicator I_4.4	**Yes**; very good data coverage and indicator is an official SDG indicator

[1] Definitions from websites listed in "Source" column of table

				(http://www.wssinfo.org/). Accessed 2019-03-01				
5	Water (SDG 6)	Infrastructure leakage index	Performance indicator for real losses, which measures the ratio of current annual real losses to system-specific unavoidable annual real losses. It is the ideal indicator for making international comparison (Winarni, 2009). The Infrastructure Leakage Index (ILI) is a performance indicator that is used to indicate the level of Real Losses (i.e. Physical leakage) in a water distribution system (Mckenzie et al. 2012). The ILI is a non-dimensional indicator and ranges from 1 to over 100 and could be considered as an alternative to the Non-Revenue Water value. An ILI value of 1 equates to the "world's best practice" and indicates that the level of physical leakage in a system is as low as it can be, while a value of ten would indicate that the physical leakage is ten times larger than the lowest value.		-	On an international level uniformity in measuring, interpreting or reporting of the ILI does not exist.	No	No, data not comparable on an international level
6	Water (SDG 6)	Non-Revenue Water	A measure of the municipal efficiency of water management, Non-Revenue Water is the sum of unbilled authorised water, commercial losses and real or physical losses.		Million m^3/annum	On an international level uniformity in measuring, interpreting or reporting of the non-revenue water does not exist.	No	No, data not comparable on an international level
7	Water (SDG 6)	Annual freshwater withdrawals, total (% of internal resources)	Annual freshwater withdrawals refer to total water withdrawals, not counting evaporation losses from storage basins. Withdrawals also include water from desalination plants in countries where they are a significant source. Withdrawals can exceed 100 percent of total renewable resources where extraction from nonrenewable aquifers or desalination plants is considerable or where there is significant water reuse. Withdrawals for agriculture and industry are total withdrawals for irrigation and livestock production and for direct industrial use (including withdrawals for cooling thermoelectric plants). Withdrawals for domestic uses include drinking water, municipal use or supply, and use for public services, commercial establishments, and homes *(World Bank 2019-03-01)*	https://data.worldbank.org/indicator/ER.H2O.FWTL.ZS?view=chart **Source:** Food and Agriculture Organization, AQUASTAT data	%	2002-2014 Limited data coverage. Indicator utilised in SDG Index for SDG 6. Need to use the most recent values from the database	Yes, 6.4.2 C060402	**Yes**, this is an official SDG indicator, and utilising the most recent values from 2002-2014 a good coverage of data is obtained. This dataset will however require Winsorization in order to remove the distorting effect of outliers, and to avoid too large a space in the dataset. Data could be truncated at 200%, which represents double the available fresh water resources of the country.
8	Water (SDG 6)	Water withdrawal in the agriculture sector	Annual quantity of self-supplied water withdrawn for irrigation, livestock and aquaculture purposes. It can include water from primary renewable and secondary freshwater resources, as well as water from over-abstraction of renewable groundwater or withdrawal from fossil groundwater, direct use of agricultural drainage water, direct use of (treated) wastewater, and desalinated water. Water for the dairy and meat industries and industrial processing of harvested	http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en **Source:** Food and Agriculture Organization, AQUASTAT data	10^9 m^3 /year	Data available from 1965-2017 with many missing data per year. Most data are available for 2000 for 68 countries.	No	No, although data is available for many countries, the data is missing for many monitoring years resulting in an incomplete dataset.

			agricultural products is included under industrial water withdrawal *(FAO 2019-05-25)*					
9	Water (SDG 6)	Water withdrawal in the industry sector	Annual quantity of self-supplied water withdrawn for industrial uses. It can include water from primary renewable and secondary freshwater resources, as well as water from over-abstraction of renewable groundwater or withdrawal from fossil groundwater, direct use of agricultural drainage water, direct use of (treated) wastewater, and desalinated water. This sector refers to self-supplied industries not connected to the public distribution network. The ratio between net consumption and withdrawal is estimated at less than 5%. It includes water for the cooling of thermoelectric and nuclear power plants, but it does not include hydropower. Water withdrawn by industries that are connected to the public supply network is generally included in municipal water withdrawal. *(FAO 2019-05-25)*	http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en **Source:** Food and Agriculture Organization, AQUASTAT data	10^9 m^3 /year	Data available from 1965-2017 with many missing data per year. Most data are available for 2000 for 93 countries.	No	No, although data is available for many countries, the data is missing for many monitoring years resulting in an incomplete dataset.
10	Water (SDG 6)	Water withdrawal in the industry sector	Annual quantity of water withdrawn primarily for the direct use by the population. It can include water from primary renewable and secondary freshwater resources, as well as water from over-abstraction of renewable groundwater or withdrawal from fossil groundwater, direct use of agricultural drainage water, direct use of (treated) wastewater, and desalinated water. It is usually computed as the total water withdrawn by the public distribution network. It can include that part of the industries and urban agriculture, which is connected to the municipal network. The ratio between the net consumption and the water withdrawn can vary from 5 to 15% in urban areas and from 10 to 50% in rural areas. *(FAO 2019-05-25)*	http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en **Source:** Food and Agriculture Organization, AQUASTAT data	10^9 m^3 /year	Data available from 1965-2017 with many missing data per year. Most data are available for 2000 for 91 countries.	No	No, although data is available for many countries, the data is missing for many monitoring years resulting in an incomplete dataset.
11	Water (SDG 6)	Fresh groundwater withdrawal (primary and secondary) - Total	Annual gross amount of water extracted from aquifers. It can include withdrawal of renewable primary and secondary groundwater, as well as water from over-abstraction of renewable groundwater or withdrawal from fossil groundwater.*(FAO 2019-05-25)*	http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en **Source:** Food and Agriculture Organization, AQUASTAT data	10^9 m^3 /year	Data available from 1965-2017 with many missing data per year. Most data are available for 2000 for 91 countries.	No	No, although data is available for many countries, the data is missing for many monitoring years resulting in an incomplete dataset.
12	Water (SDG 6)	Desalinated water produced	Water produced annually by desalination of brackish or salt water. It is estimated annually on the basis of the total capacity of water desalination installations..*(FAO 2019-05-25)*	http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en **Source:** Food and Agriculture Organization, AQUASTAT data	10^9 m^3 /year	Data available from 1980-2015 with many missing data per year. Most data are available for 2000 for 49 countries.	No	No, although data is available for many countries, the data is missing for many monitoring years resulting in an incomplete dataset.
13	Water (SDG 6)	Treated municipal water	Treated wastewater (primary, secondary and tertiary) annually produced by municipal wastewater treatment facilities in the country. Primary treatment:municipal wastewater effectively treated by a physical and/or chemical process involving	http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en **Source:** Food and Agriculture Organization, AQUASTAT data	10^9 m^3 /year	Data available from 1967-2017 with many missing data per year. Most data are	No	No, although data is available for many countries, the data is missing for many monitoring years

			settlement of suspended solids, or other process in which the BOD5 of the incoming wastewater is reduced by at least 20% and the total suspended solids of the incoming wastewater are reduced by at least 50% before discharge. Treatment processes can include: sedimentation tank, septic tank, skimming, chemical enhanced primary treatment. Secondary treatment:municipal wastewater effectively treated by a process generally involving biological treatment with a secondary settlement or other process, resulting in a BOD removal of at least 70% and a COD removal of at least 75% before discharge. Treatment processes can include: aerated lagoon, activated sludge, up-flow anaerobic sludge blanket, trickling filters, rotating biological contactors, oxidation ditch, settling basin digester. For the purpose of this database natural biological treatment processes are also considered under secondary treatment as the constituents of the effluents from this type of treatment is similar to the conventional secondary treatment. Natural biological treatment refers to the process other than conventional wastewater treatment (primary, secondary, tertiary). This treatment makes use of natural bio-chemical processes to treat wastewater and can include: waste stabilization pond, constructed wetlands, overland treatment, nutrient film techniques, soil aquifer treatment, high-rate algal pond, floating aquatic macrophyte systems. Tertiary treatment:municipal wastewater effectively treated by a process in addition to secondary treatment of nitrogen and/or phosphorous and/or any other specific pollutant affecting the quality or a specific use of water: microbiological pollution, colour, etc. This treatment is meant to remove at least 95% for BOD and 85% for COD and/or a nitrogen removal of at least 70% and/or a phosphorus removal of at least 80% and/or a microbiological removal. Treatment process can include: membrane filtration (micro-; nano-; ultra- and reverse osmosis), infiltration / percolation, activated carbon, disinfection (chlorination, ozone, UV). ..*(FAO 2019-05-25)*			available for 2012 for 25 countries.		resulting in an incomplete dataset.
14	Water (SDG 6)	Direct use of treatment municipal water	Treated municipal wastewater (primary, secondary, tertiary effluents) directly used, i.e. with no or little prior dilution with freshwater during most of the year.	http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en **Source:** Food and Agriculture Organization, AQUASTAT data	10^9 m^3 /year	Data available from 1967-2013 with many missing data per year. Most data are available for 2000 for 15 countries.	No	No, although data is available for many countries, the data is missing for many monitoring years resulting in an incomplete dataset.
15	Water (SDG 6)	Environmental flow requirements	The quantity and timing of freshwater flows and levels necessary to sustain aquatic ecosystems which, in turn, support human cultures, economies, sustainable	http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en **Source:** Food and Agriculture Organization, AQUASTAT data	10^9 m^3 /year	Data available from 1962-2017 with many missing data per year.	No	Yes, it is important that water's contribution required for sustaining the environment is taken

			livelihoods, and wellbeing" (Adapted from Arthington, A.H., et al. 2018).			Most data are available for 2017 for 154 countries.		into account. Good correlation with renewable internal fresh water resources (0.58)
16	Water (SDG 6)	Percentage of area equipped for irrigation by surface water	Area equipped for irrigation irrigated by surface water as percentage of the total area equipped for irrigation	http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en **Source:** Food and Agriculture Organization, AQUASTAT data	%	Data available from 1962-2014 with many missing data per year. Most data are available for 1994 for 19 countries.	No	No, although data is available for many countries, the data is missing for many monitoring years resulting in an incomplete dataset.
17	Water (SDG 6)	Percentage of area equipped for irrigation by ground water	Equipped for irrigation area irrigated by groundwater as percentage of the total equipped for irrigation area.	http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en **Source:** Food and Agriculture Organization, AQUASTAT data	%	Data available from 1962-2014 with many missing data per year. Most data are available for 1994 for 17 countries.	No	No, although data is available for many countries, the data is missing for many monitoring years resulting in an incomplete dataset.
18	Water (SDG 6)	Percentage of total grain production irrigated	Percent of the total grain production of the country (rainfed and irrigated) that is irrigated in a given year, expressed in percentage.	http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en **Source:** Food and Agriculture Organization, AQUASTAT data	%	Data available from 1984-1995 with many missing data per year. Most data are available for 1994 for 13 countries.	No	No, although data is available for many countries, the data is missing for many monitoring years resulting in an incomplete dataset.
19	Water (SDG 6)	Renewable internal freshwater resources per capita (cubic meters)	Renewable internal freshwater resources flows refer to internal renewable resources (internal river flows and groundwater from rainfall) in the country. Renewable internal freshwater resources per capita are calculated using the World Bank's population estimates (*World Bank 2019-03-01*).	https://data.worldbank.org/indicator/ER.H2O.INTR.PC?view=chart **Source:** Food and Agriculture Organization, AQUASTAT data	m^3/capita	2014 Very good data coverage	No	**Yes**, very good data coverage, and the "per capita" unit provides a helpful measure between countries with an indicator of relative scarcity. Good correlation with annual fresh water reseources, but not too high to warrant exclusion (0.78)
20	Water (SDG 6)	Renewable internal freshwater resources, total (billion cubic meters)	Renewable internal freshwater resources flows refer to internal renewable resources (internal river flows and groundwater from rainfall) in the country (World Bank 2019-03-04).	https://data.worldbank.org/indicator/ER.H2O.INTR.K3?view=chart **Source:** Food and Agriculture Organization, AQUASTAT data	Billion m^3	2014 Very good data coverage	No	No, this is the same data as the "Renewable internal freshwater resources per capita (cubic meters)" but as a quantum instead of per capita
21	Water (SDG 6)	Hydropower electricity capacity (MW)	Hydropower and renewable hydropower	https://www.irena.org/Statistics/View-Data-by-Topic/Capacity-and-Generation/Technologies **Source**: Source: IRENA (2019), Renewable capacity statistics 2019; and IRENA (2018), Renewable Energy Statistics 2018, The International Renewable Energy Agency, Abu Dhabi.	MW	Data available from 2000-2018 with minimal missing data per year. Most data are available for 2018 for 159 countries.	No	No, this data is included in the renewable energy consumption and output indicators

22	Water (SDG 6)	Hydropower electricity generation (GWh)	Hydropower and renewable hydropower	https://www.irena.org/Statistics/View-Data-by-Topic/Capacity-and-Generation/Technologies **Source**: Source: IRENA (2019), Renewable capacity statistics 2019; and IRENA (2018), Renewable Energy Statistics 2018, The International Renewable Energy Agency, Abu Dhabi.	GWh	Data available from 2000-2016 with minimal missing data per year. Most data are available for 2016 for 159 countries.	No	No, this data is included in the renewable energy consumption and output indicators
23	Water (SDG 6)	Average precipitation in depth (mm per year)	Average precipitation is the long-term average in depth (over space and time) of annual precipitation in the country. Precipitation is defined as any kind of water that falls from clouds as a liquid or a solid (*World Bank 2019-03-04*).	https://data.worldbank.org/indicator/AG.LND.PRCP.MM **Source:** Food and Agriculture Organization, electronic files and website	mm/ year	2014 Very good data coverage	No	**Yes**; this data is widely available and provides a good indication of available fresh water. This indicator directly influences food production and energy generation. Good correlation with annual freshwater withdrawals
24	Water (SDG 6)	Proportion of wastewater safely treated	Percentage of wastewater generated by households (sewage and faecal sludge) and economic activities (based on ISIC categories) that is safely treated (UN Water, 2016).	http://www.fao.org/nr/water/aquastat/data/query/results.html Source: FAO. 2016. AQUASTAT Main Database, Food and Agriculture Organization of the United Nations (FAO). Website accessed on [13/03/2019 8:28]	10^9 m^3/year	Data available from 1993-2017 for 93 countries with missing data entries for most years	Yes; indicator 6.3.1	No, although data is available for many countries, the data is missing for many monitoring years resulting in an incomplete dataset.
25	Water (SDG 6)	Proportion of bodies of water with good ambient water quality	Percentage of water bodies (area) in a country with good ambient water quality. "Good" indicates an ambient water quality that does not damage ecosystem function and human health according to core ambient water quality parameters. Overall water quality is estimated based on a core set of five parameters that inform on major water quality impairments present in many parts of the world: electric conductivity/total dissolved solids; percentage dissolved oxygen; dissolved inorganic nitrogen/total nitrogen; dissolved inorganic phosphorus/total phosphorus; and faecal coliform/Escherichia coli bacteria (UNWater, 2016).	UNEP GEMStat		Initial baseline data collected in 2017 for 48 countries. Data is not accessible yet	Yes; indicator 6.3.2	No, only baseline data has been collected for 48 countries. The baseline data is not accessible and cannot be used.
26	Water (SDG 6)	Change in water-use efficiency over time	Output from a given economic activity (based on ISIC categories), per volume of net water withdrawn by the economic activity. This indicator includes water use by all economic activities, focusing on agriculture (excluding the portion generated by rain-fed agriculture), manufacturing, electricity, and water collection, treatment and supply (looking at distribution efficiency and capturing network leakages). By assessing changes over time, the sectoral values can be aggregated into one (UNWater, 2016).	http://www.fao.org/nr/water/aquastat/data/query/results.html	USD/m^3	Data can be calculated from water used per sector and economic contribution, but data specific for this indicator is not available.	Yes; indicator 6.4.1	No; this indicator is calculated per economic sector in a country and not as one value per country.
27	Water (SDG 6)	Degree of integrated water resources	The degree to which IWRM is implemented, by assessing the four components of policies, institutions, management tools and financing. It takes into account	http://iwrmdataportal.unepdhi.org/dataoverview.html	%	Data is available for 2017 for 175 countries.	Yes; indicator 6.5.1	**Yes**; IWRM implementation provides a good indication of

		management implementation (0-100)	the various users and uses of water, with the aim of promoting positive social, economic and environmental impacts at all levels, including the transboundary level, where appropriate (UNWater, 2016).					water governance, and has a strong correlation with the implementation of basic drinking water and sanitation facilities.
28	Water (SDG 6)	Proportion of transboundary basin area with an operational arrangement for water cooperation	Percentage of transboundary basin area within a country that has an operational agreement or other arrangement for water cooperation. For the purpose of the indicator, "basin area" is defined for surface waters as the extent of the catchment, and for groundwater as the extent of the aquifer. An "arrangement for water cooperation" is a bilateral or multilateral treaty, convention, agreement or other formal arrangement among riparian countries that provides a framework for cooperation on transboundary water management. The criteria for the arrangement to be considered "operational" are based on key aspects of substantive cooperation in water management, such as the existence of institutional mechanisms, regular communication among riparian countries, joint or coordinated management plans or objectives, as well as a regular exchange of data and information (UNWater, 2016).	http://geftwap.org/data-portal	%	Data is not included in the National Statistical Systems yet.	Yes; indicator 6.5.2	No; there is no usable data available yet, but this indicator will play an important role in terms of catchment management.
29	Water (SDG 6)	Change in the extent of water-related ecosystems over time	Changes over time in (1) the spatial extent of water-related ecosystems (wetlands, forests and drylands); (2) the quantity of water in ecosystems (rivers, lakes and groundwater); and (3) the resulting health of ecosystems. In addition, indicator 6.3.2 on ambient water quality and indicator 6.4.2 on environmental water requirements are critically important for understanding ecosystems and need to be factored into the assessment of indicator 6.6.1 (UNWater, 2016).	Not available yet	-	Data not available or not easily accessible.	Yes; indicator 6.6.1	No, insufficient data at this time.
30	Water (SDG 6)	Amount of water- and sanitation-related official development assistance that is part of a government-coordinated spending plan	Amount and percentage of ODA that is included in a government coordinated spending plan, whether: (1) on treasury or (2) on budget. ODA flows are official financing with the main objective of promoting economic development and welfare of developing countries; they are concessional in character with a grant element of at least 25%. By convention, ODA flows comprise contributions from donor government agencies, at all levels, to developing countries, either bilaterally or through multilateral institutions. A government coordinated spending plan is defined as a financing plan/budget for water and sanitation projects, clearly assessing the available sources of finance and strategies for financing future needs (UNWater, 2016).	https://datacatalog.worldbank.org/ Source: The World Bank	US$ per year	Data available from 2002-2011 for 59 countries	Yes; indicator 6.a.1	No; data is specific to developing countries and only covers 59 countries which is inefficient for the purpose of developing the WEF nexus index.
31	Water (SDG 6)	Proportion of local administrative units with established and operational	Percentage of local administrative units within a country with established and operational policies and procedures for participation of local communities in water and sanitation management. Local	Not available	%	None	Yes; indicator 6.b.1	No; there is no usable data available yet.

		policies and procedures for participation of local communities in water and sanitation management	administrative units refer to subdistricts, municipalities, communes or other local community level units covering both urban and rural areas to be defined by the government. Policies and procedures for participation of local communities in water and sanitation management define a mechanism by which individuals and communities can meaningfully contribute to decisions and directions on water and sanitation management (UNWater, 2016).					
32	Water (SDG 6)	Average evapotranspiration in volume (mm per year)	Important for water management policies in arid countries. Would affect water allocation	http://data.un.org/Data.aspx?d=ENV&f=variableID%3A7 **Source**: United Nations Statistics Division	Million m^3/annum	1990-2015 Fair coverage Data available for approximately 64 countries	No	No; data is only available for 64 countries. The JRC-COIN guideline is that at an indicator level 65% of countries should have valid data.
33	Water (SDG 6)	Dam storage capacity	Water storage capacity as a proxy for ability to manage Rainfall variability between seasons. Underscores the importance of a basic platform of hydraulic infrastructure, but insensitive application may encourage 'hydraulic mission' and heavy engineering at the expense of other solutions	http://www.fao.org/nr/water/aquastat/data/query/index.html Source: FAO. 2016. AQUASTAT Main Database, Food and Agriculture Organization of the United Nations (FAO). Website accessed on [13/03/2019 8:28]	km^3	Data available from 1990-2017 for 130 countries, with missing data for some years.	No	No; although there is data per country available, it is fragmented. Also, it is uncertain whether dam storage is positive or negative, since there is a conflict between system flows and storage
34	Water (SDG 6)	Virtual water footprint	Many potential policy applications and implications, e.g. could be used to focus attention on the potential for virtual water trade to mitigate against localised water scarcity, but thinking is relatively young and virtual water footprint data needs careful interpretation	Mekonnen, M.M. and Hoekstra, A.Y. (2010) The green, blue and grey water footprint of crops and derived crop products, Value of Water Research Report Series No. 47, UNESCO-IHE, Delft, the Netherlands. http://www.waterfootprint.org/Reports/Report47-WaterFootprintCrops-Vol1.pdf **Source**: Water Footprint Network	ton of crop or derived crop product	1996-2005 (collated data)	No	No; data is available, but it has been collated into a single dataset instead of data per country.
35	Water (SDG 6)	Total agricultural water managed area	Sum of total area equipped for irrigation and areas with other forms of agricultural water management (non-equipped flood recession cropping area and non-equipped cultivated wetlands and inland valley bottoms) (FAO, 2019-03-13)	http://www.fao.org/nr/water/aquastat/data/query/index.html Source: FAO. 2016. AQUASTAT Main Database, Food and Agriculture Organization of the United Nations (FAO). Website accessed on [13/03/2019 8:28]	1000 ha	Data available from 1988-2017 for 52 countries, with missing data for some years.	No	No; data is only available for 52 countries. The JRC-COIN guideline is that at an indicator level 65% of countries should have valid data.
36	Water (SDG 6)	Population affected by water related diseases	Three types of water-related diseases exist: (i) water-borne diseases are those diseases that arise from infected water and are transmitted when the water is used for drinking or cooking (for example cholera, typhoid); (ii) water-based diseases are those in which water provides the habitant for host organisms of parasites ingested (for example shistomasomiasis or bilharzia); (iii) water-related insect vector diseases are those in which insect vectors rely on water as habitat but transmission is not through direct contact with	http://www.fao.org/nr/water/aquastat/data/query/index.html Source: FAO. 2016. AQUASTAT Main Database, Food and Agriculture Organization of the United Nations (FAO). Website accessed on [13/03/2019 8:28]	1000 inhabitants	Data available from 1992-2011 for 32 countries, with most data missing for some years.	No	No; data is only available for 32 countries. The JRC-COIN guideline is that at an indicator level 65% of countries should have valid data.

			water (for example malaria, onchocerciasis or river blindness, elephantiasis).					
37	Energy (SDG 7)	Access to electricity (% of the population)	Access to electricity is the percentage of population with access to electricity. Electrification data are collected from industry, national surveys and international sources (*World Bank 2019-03-04*)	https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS?view=chart **Source:** World Bank, Sustainable Energy for All (SE4ALL) database from the SE4ALL Global Tracking Framework led jointly by the World Bank, International Energy Agency, and the Energy Sector Management Assistance Program.	%	2016 Very good data coverage. Indicator utilised in SDG Index for SDG 7	Yes, Indicator 7.1.1 (C070101)	**Yes**; essential indicator for SDG 7 with good data coverage.
38	Energy (SDG 7)	Renewable energy consumption (% of total final energy consumption)	Renewable energy consumption is the share of renewables energy in total final energy consumption (*World Bank 2019-03-04*).	https://data.worldbank.org/indicator/EG.FEC.RNEW.ZS **Source:** World Bank, Sustainable Energy for All (SE4ALL) database from the SE4ALL Global Tracking Framework led jointly by the World Bank, International Energy Agency, and the Energy Sector Management Assistance Program.	%	2015 Very good data coverage. Indicator utilised in SDG Index for SDG 7	Yes, Indicator 7.2.1 (C070201)	**Yes**; essential indicator for SDG 7 with good data coverage.
39	Energy (SDG 7)	Renewable electricity output (% of total electricity output)	Renewable electricity is the share of electricity generated by renewable power plants in total electricity generated by all types of plants (*World Bank 2019-03-04*).	https://data.worldbank.org/indicator/EG.ELC.RNEW.ZS?view=chart **Source:** IEA Statistics © OECD/IEA 2018 (http://www.iea.org/stats/index.asp)	%	2015 Very good data coverage	No	**Yes**; since "Renewable energy consumption" refers to energy, while this indicator considers electricity only. Correlation with Renewable energy consumption is good, but not too high
40	Energy (SDG 7)	Total greenhouse gas emissions (kt of CO_2 equivalent)	Total greenhouse gas emissions in kt of CO_2 equivalent are composed of CO_2 totals excluding short-cycle biomass burning (such as agricultural waste burning and Savannah burning) but including other biomass burning (such as forest fires, post-burn decay, peat fires and decay of drained peatlands), all anthropogenic CH_4 sources, N_2O sources and F-gases (HFCs, PFCs and SF6). (*World Bank 2019-03-04*)	https://data.worldbank.org/indicator/EN.ATM.GHGT.KT.CE?view=chart **Source:** European Commission, Joint Research Centre (JRC)/Netherlands Environmental Assessment Agency (PBL). Emission Database for Global Atmospheric Research (EDGAR), EDGARv4.2 FT2012: http://edgar.jrc.ec.europa.eu/	kt of CO_2 equivalent	2012 Very good data coverage	No	No; since this indicator represents all of the GHGs as CO_2 equivalent and includes biomass burning, methane, and other non-energy related GHG sources.
41	Energy (SDG 7)	CO_2 emissions (metric tons per capita)	Carbon dioxide emissions are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring (*World Bank 2019-03-05*).	https://data.worldbank.org/indicator/EN.ATM.CO2E.PC **Source:** Carbon Dioxide Information Analysis Centre, Environmental Sciences Division, Oak Ridge National Laboratory, Tennessee, United States. https://data.worldbank.org/indicator/EN.ATM.CO2E.PC	metric tons per capita	2014 Very good data coverage. Similar indicator utilised in SDG Index for SDG 7	No	**Yes**; this data provides an indication of fossil fuel-related power generation. The per capita rating takes cognisance of the size of the impact relative to the population
42	Energy (SDG 7)	CO_2 emissions (kt)	Carbon dioxide emissions are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring (*World Bank 2019-03-05*).	https://data.worldbank.org/indicator/EN.ATM.CO2E.KT?view=chart **Source:** Carbon Dioxide Information Analysis Centre, Environmental Sciences Division, Oak Ridge National Laboratory, Tennessee, United States.	kt	2014 Very good data coverage	No	No; same parameter being measured as CO2 emissions (metric tons per capita), except that this is not per capita, but the quantum per country.

43	Energy (SDG 7)	Energy use (kg of oil equivalent per capita)	Energy use refers to use of primary energy before transformation to other end-use fuels, which is equal to indigenous production plus imports and stock changes, minus exports and fuels supplied to ships and aircraft engaged in international transport (*World Bank 2019-03-05*).	https://data.worldbank.org/indicator/EG.USE.PCAP.KG.OE?view=chart **Source:** IEA Statistics © OECD/IEA 2014 (http://www.iea.org/stats/index.asp)	kg of oil equivalent per capita	2015,2014,2013 Good data coverage, although will need to utilise latest data since very limited data for 2015.	No, but consider including 7.1.2 "Proportion of population with primary reliance on clean fuels and technology"	No; although this is a relevant indicator with readily available data it has a very high correlation (0.94) with electric power consumption per capita, and would therefore constitute 'double accounting'. It is therefore excluded
44	Energy (SDG 7)	Energy imports, net (% of energy use)	Net energy imports are estimated as energy use less production, both measured in oil equivalents. A negative value indicates that the country is a net exporter. Energy use refers to use of primary energy before transformation to other end-use fuels, which is equal to indigenous production plus imports and stock changes, minus exports and fuels supplied to ships and aircraft engaged in international transport (*World Bank 2019-03-05*).	https://data.worldbank.org/indicator/EG.IMP.CONS.ZS?view=chart **Source:** IEA Statistics © OECD/IEA 2014 (http://www.iea.org/stats/index.asp)	%	2015,2014,2013 Good data coverage, although will need to utilise latest data since very limited data for 2015.	No	**Yes**; this indicator provides a helpful indication of national energy security. But this indicator will be truncated at zero to exclude exports, since the primary concern is energy security and the indicator is essentially measuring imports and exports.
45	Energy (SDG 7)	Firms experiencing electrical outages (% of firms)	Percent of firms experiencing electrical outages during the previous fiscal year (*World Bank 2019-03-05*).	https://data.worldbank.org/indicator/IC.ELC.OUTG.ZS **Source:** World Bank, Enterprise Surveys	%	2013-2017 Relatively poor data coverage. Will need to use the latest value	No	No, relatively poor data coverage.
46	Energy (SDG 7)	Electric power consumption (kWh per capita)	Electric power consumption measures the production of power plants and combined heat and power plants less transmission, distribution, and transformation losses and own use by heat and power plants (*World Bank 2019-03-05*).	https://data.worldbank.org/indicator/EG.USE.ELEC.KH.PC?view=chart **Source**: IEA Statistics © OECD/IEA 2014 (http://www.iea.org/stats/index.asp)	kWh per capita	2014 Very good data coverage	No	**Yes;** very good data coverage and very relevant, since it provides a helpful indication of a nation's generation capacity.
47	Energy (SDG 7)	Proportion of population with primary reliance on clean fuels and technology	This is measured as the share of the total population with access to clean fuels and technologies for cooking. Access to clean fuels or technologies such as clean cookstoves reduce exposure to indoor air pollutants, a leading cause of death in low-income households (UN Stats, 2018)	Households that use solid fuels for cooking: http://apps.who.int/gho/data/view.main.vEQSOLIDFUELSTOTv Source: World Health Organization (MICS and DHS)	%	Data available from 1998-2013 for 93 countries, with data missing for some years.	Yes; indicator 7.1.2	No; data is only available for 93 countries. The JRC-COIN guideline is that at an indicator level 65% of countries should have valid data.
48	Energy (SDG 7)	Energy intensity measured in terms of primary energy and GDP	This is measured as the energy intensity of economies (collectively across all sectors). Energy intensity is measured as the quantity of kilowatt-hours produced per 2011 international-$ of gross domestic product (kWh per 2011 int-$) (UN Stats, 2018). Total primary energy supply is defined as the sum of production and imports subtracting exports and storage changes.	https://www.iea.org/statistics/?country=WORLD&year=2016&category=Energy%20supply&indicator=TPESbyGDP&mode=map&dataTable=BALANCES **Source**: International Energy Agency	TPES/GDP	Data available for 2016 for 142 countries, with data missing for some years.	Yes; indicator 7.3.1	No; this indicator is an SDG indicator and data are available for 142 countries, but it has a negative, low correlation with all other indicators associated with availability.
49	Energy (SDG 7)	International financial flows to developing countries in support	The flows covered by the OECD are defined as all official loans, grants and equity investments received by countries on the DAC List of ODA Recipients from foreign governments and multilateral agencies, for the	http://resourceirena.irena.org/gateway/dashboard/?topic=6&subTopic=8 **Source**: International Renewable Energy Agency	Million USD	Data is available from 2006-2017 for 141 countries	Yes; indicator 7. a.1	No; although this indicator is an SDG indicator and data are available for 141

		of clean energy research and development and renewable energy production, including in hybrid systems	purpose of clean energy research and development and renewable energy production, including in hybrid systems extracted from the OECD/DAC Creditor Reporting System (CRS). The flows covered by IRENA are defined as all additional loans, grants and equity investments received by developing countries (defined as countries in developing regions, as listed in the UN M49 composition of regions) from all foreign governments, multilateral agencies and additional development finance institutions (including export credits, where available) for the purpose of clean energy research and development and renewable energy production, including in hybrid systems. These additional flows cover the same technologies and other activities (research and development, technical assistance, etc.) as listed above and exclude all flows extracted from the OECD/DAC CRS (UN Stats, 2018)			with data missing for some years.		countries developed/donor and developing countries who have significant domestic expenditure on renewable energy projects are 'penalised' in the calculation of this index. It was therefore decided to exclude this indicator from the composite indicator
50	Energy (SDG 7)	Investments in energy efficiency as a percentage of GDP and the amount of foreign direct investment in financial transfer for infrastructure and technology to sustainable development services	Not defined yet.	Not available	%	None	Yes; indicator 7. b.1	No; the definition for this indicator is not yet well defined and therefore not well understood yet. There is no data easily available for this indicator.
51	Energy (SDG 7)	Amount of fossil-fuel subsidies per unit of GDP (production and consumption) and as a proportion of total national expenditure on fossil fuels	In order to measure fossil fuel subsidies at the national, regional and global level, three sub-indicators are recommended for reporting on this indicator: 1) direct transfer of government funds; 2) induced transfers (price support); and as an optional sub-indicator 3) tax expenditure, other revenue foregone, and underpricing of goods and services. The definitions of the IEA Statistical Manual (IEA, 2005) and the Agreement on Subsidies and Countervailing Measures (ASCM) under the World Trade Organization (WTO) (WTO, 1994) are used to define fossil fuel subsidies. Standardised descriptions from the United Nations Statistical Office's Central Product Classification should be used to classify individual energy products. It is proposed to drop the wording "as a proportion of total national expenditure on fossil fuels" and thus this indicator is effectively "Amount of fossil fuel subsidies per unit of GDP (production and consumption)". (UN Stats, 2018)	Not available	USD/GDP	None; baseline assessment was conducted. Reporting on induced transfers started in 2018; reporting on data for direct transfers and tax revenue will take place in 2020.	Yes; indicator 12.c.1	No; no data readily available

52	Food (SDG 2)	Prevalence of undernourishment[2]	The prevalence of undernourishment expresses the probability that a randomly selected individual from the population consumes a number of calories that is insufficient to cover her/his energy requirement for an active and healthy life. The indicator is computed by comparing a probability distribution of habitual daily dietary energy consumption with a threshold level called the minimum dietary energy Requirement. Both are based on the notion of an average individual in the reference population (*FAO 2019-03-05*).	http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk **Source:** FAOSTAT and ESS calculations:	%	2015-2017 Very good data coverage. Indicator utilised in SDG Index for SDG 2	Yes, 2.1.1 (C020101). Could consider a health indicator such as 3.2.1 "Under-5 mortality rate" as an additional indicator of 'healthy' food?	**Yes**; it was the official Millennium Development Goal indicator for Goal 1, Target 1.9, and is now an SDG indicator
53	Food (SDG 2)	Percentage of children under 5 years of age affected by wasting[3] [4]	Wasting prevalence is the proportion of children under five whose weight for height is more than two standard deviations below the median for the international reference population ages 0-59 months (*FAO 2019-03-05*).	http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk **Source:** World Development Indicators: http://data.worldbank.org/indicator/SH.STA.WAST.ZS + UNICEF et al. (2016) report an average prevalence of wasting in high-income countries of **0.75%**, which has been assumed for high-income countries with missing data. The classification as a high-income country is based on the World Bank's listing of high-income countries: https://data.worldbank.org/income-level/high-income	%	2016 Limited data. Need to utilise latest since coverage for the final year alone is scarce. Indicator utilised in SDG Index for SDG 2	No	**Yes**; if there is a strong correlation of data with SDG indicator 2.2.1's data, one of the two indicators will be used to avoid noise in the dataset. However the correlation is good, but not too high. Both indicators can therefore be retained.
54	Food (SDG 2)	Percentage of children under 5 years of age who are stunted[5]	Percentage of stunting (height-for-age less than -2 standard deviations of the WHO Child Growth Standards median) among children aged 0-59 months (*FAO 2019-03-05*).	http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk **Source:** World Development Indicators: http://data.worldbank.org/indicator/SH.STA.WAST.ZS + UNICEF et al. (2016) report an average prevalence of wasting in high income countries of **2.58%**, which has been assumed for high-income countries with missing data. The classification as a high-income country is based on the World Bank's listing of high-income countries: https://data.worldbank.org/income-level/high-income	%	2016 Limited data. Need to utilise most recent coverage for the final year alone is scarce. Indicator utilised in SDG Index for SDG 2	Yes, 2.2.1 (C020201)	**Yes**; this is an SDG indicator with sufficient data available for 153 countries.
55	Food (SDG 2)	The depth of the food deficit	The depth of the food deficit indicates how many calories would be needed to lift the undernourished from their status, everything else being constant. The	http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk Version 15 Sep 2017	kCal/ day	2014-2016 Very good data coverage.	No	No – Many countries, such as Denmark, Finland, Switzerland,

[2] "This is the traditional FAO hunger indicator, adopted as official Millennium Development Goal indicator for Goal 1, Target 1.9." (http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk).

[3] "Child growth is the most widely used indicator of nutritional status in a community and is internationally recognized as an important public-health indicator for monitoring health in populations. In addition, children who suffer from growth retardation as a result of poor diets and/or recurrent infections tend to have a greater risk of suffering illness and death." (http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk)

[4] The "two official indicators for the hunger target [are] the prevalence of undernourishment and the proportion of underweight children under 5 years of age" (http://www.fao.org/3/a-i4671e.pdf)

[5] "This indicator belongs to a set of indicators whose purpose is to measure nutritional imbalance and malnutrition resulting in undernutrition (assessed by underweight, stunting and wasting) and overweight. Child growth is the most widely used indicator of nutritional status in a community and is internationally recognized as an important public-health indicator for monitoring health in populations. In addition, children who suffer from growth retardation as a result of poor diets and/or recurrent infections tend to have a greater risk of suffering illness and death." (http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk)

		(kilocalories per person per day)[6]	average intensity of food deprivation of the undernourished, estimated as the difference between the average dietary energy requirement and the average dietary energy consumption of the undernourished population (food-deprived), is multiplied by the number of undernourished to provide an estimate of the total food deficit in the country, which is then normalized by the total population (*World Bank 2019-03-06*).	**Source**: ESS calculations				Sweden, Norway have no data but are assumed to be close to zero (patched to 2.5 for geometric mean). Although this indicator has very good data, it has a very high correlation with the prevalence of undernourishment (0.95), and it has therefore been excluded in order to avoid double accounting
56	Food (SDG 2)	Average protein supply[7]	National average protein supply (expressed in grams per caput per day) (*FAO 2019-03-06*)	http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk **Source**: FAOSTAT	gr/caput/day	2011-2013 Very good data coverage	No, but it is FAO Indicator I_1.4	**Yes**; very good data availability and provides an indication of a healthy, varied diet
57	Food (SDG 2)	Prevalence of obesity in the adult population (18 years and older)	Prevalence of obesity in the adult population is the percentage of adults ages 18 and over whose Body Mass Index (BMI) is more than 30 kg/m^2. Body Mass Index (BMI) is a simple index of weight-for-height or the weight in kilograms divided by the square of the height in meters (*FAO 2019-05-06*).	http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk **Source**: World Health Organization Global Health Observatory (GHO) http://apps.who.int/gho/data/node.main.A900A?lang=en	%	2016 Very good data coverage. Indicator utilised in SDG Index for SDG 2	No, but it is FAO Indicator I_4.8	**Yes**; since it is utilised within the SDG Index. Although it has a negative correlation with the levels of undernourishment, stunting and wasting, it measures a different portion of the population, i.e. adults >18 years old vs children <5 years old. It is viewed as being a key indicator of access to food despite the negative correlation with the other indicators listed in the access to food sub-index
58	Food (SDG 2)	Average dietary energy supply adequacy[8]	The indicator expresses the Dietary Energy Supply (DES) as a percentage of the Average Dietary Energy Requirement (ADER). Each country's or region's average supply of calories for food consumption is normalized by the average dietary energy requirement estimated for its population to provide an index of adequacy of the food supply in terms of calories (*FAO 2019-05-06*).	http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk **Source**: FAOSTAT and ESS calculations	%	2015-2017 Very good data coverage	No, but it is FAO Indicator I_1.1	**Yes**; less than 10% missing data

[6] "Complementary indicator to assess the multiple dimensions and manifestations of food insecurity and the policies for more effective interventions and responses" (http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk – *not available in latest update of downloadable data)

[7] "This indicator provides information on the quality of the diet" (http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk)

[8] "Analysed together with the prevalence of undernourishment, it allows discerning whether undernourishment is mainly due to insufficiency of the food supply or to particularly bad distribution." (http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk)

59	Food (SDG 2)	Cereal import dependency ratio	The cereal imports dependency ratio tells how much of the available domestic food supply of cereals has been imported and how much comes from the country's own production. It is computed as (cereal imports - cereal exports)/(cereal production + cereal imports - cereal exports) * 100 Given this formula the indicator assumes only values <= 100. Negative values indicate that the country is a net exporter of cereals (*FAO 2019-03-06*).	http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96UkBU: **Source:** FAOSTAT and ESS calculations	%	2011-2013 Good data coverage	No, but it is FAO indicator I_3.1	No; it is a good indicator, but several high-income countries do not measure this ratio since it is not relevant to them (30.9% missing data for 181 countries). This indicator can be truncated at zero in order to exclude exports from this indicator, since the indicator is essentially measuring both imports and exports. Imports are important to this index as they speak of the level of self-sufficiency in food production and security. Yet this indicator has a negative correlation with the other indicators within the "Access" sub-pillar of the "Food"sub-index, and is therefore excluded.
60	Food (SDG 2)	Prevalence of severe food insecurity in the total population[9]	The prevalence of severe food insecurity in an estimate of the percentage of people in the population who live in households classified as severely food insecure. The assessment is conducted using data collected with the Food Insecurity Experience Scale or a compatible experience-based food security measurement questionnaire (such as the HFSSM, the HFIAS, the EBIA, the ELCSA, etc.). The probability to be food insecure is estimated using the one-parameter logistic Item Response Theory model (the Rasch model) and thresholds for classification are made cross country comparable by calibrating the metrics obtained in each country against the FIES global reference scale, maintained by FAO. The threshold to classify "severe" food insecurity corresponds to the severity associated with the item "having not eaten for an entire day" on the global FIES scale. In simpler terms, a household is classified as severely food insecure when at least one adult in the household has reported to have been exposed, at times during	http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk **Source:** National surveys/Gallup World Poll and ESS calculations	%	2015-2017 Data missing for many countries	Yes, indicator 2.1.2 (C020102) and FAO indicator I_2.4	No; >60% of countries do not have records for this indicator. This is very low. The JRC-COIN guideline is that at an indicator level 65% of countries should have valid data. On this basis, this indicator is unfortunately excluded. It is unfortunate because this is an official SDG indicator.

[9] "This is indicator 2.1.2 in the SDG framework, to monitor target 2.1 ("By 2030, end hunger and ensure access by all people, […], to safe, nutritious and sufficient food all year round")." (http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk)

			the year, to several of the most severe experiences described in the FIES questions, such as to have been forced to reduce the quantity of the food, to have skipped meals, having gone hungry, or having to go for a whole day without eating because of a lack of money or other resources. It is an indicator of lack of food access (FAO 2019-03-06)					
61	Food (SDG 2)	Number of severely food insecure people	Estimated number of people living in households classified as severely food insecure. It is calculated by multiplying the estimated percentage of people affected by severe food insecurity (I_2.4) by the total population.	http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk **Source:** ESS calculations	Millions of people	2015-2017 Poor data coverage	No	No, for same reason as "Prevalence of severe food insecurity in the total population"
62	Food (SDG 2)	The share of food expenditure of the poor[10]	The proportion of food consumption over total consumption (food and non-food) for the lowest income quintile of the population. Due to the way in which the share of food expenditures is defined in the sources of data, this indicator captures the monetary value of food obtained from all the possible food sources (purchases, own-production, gift, in-kind payment, etc.), rather than just the monetary value of purchased food. Total consumption expenditures include both food and non-food expenditures and exclude non-consumption expenditures such as taxes, insurances, etc.	http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk **Source:** ESS calculations	%	2014* Very poor data coverage	No	No, very poor data coverage, and this indicator is not included in latest list of FAO indicators.
63	Food (SDG 2)	Cereal yield	Cereal yield, measured as kilograms per hectare of harvested land, includes wheat, rice, maize, barley, oats, rye, millet, sorghum, buckwheat, and mixed grains. Production data on cereals relate to crops harvested for dry grain only. Cereal crops harvested for hay or harvested green for food, feed, or silage and those used for grazing are excluded. The FAO allocates production data to the calendar year in which the bulk of the harvest took place. Most of a crop harvested near the end of a year will be used in the following year (*World Bank 2019-03-06*).	https://data.worldbank.org/indicator/AG.YLD.CREL.KG?view=chart Source: World Bank	kg per hectare	2016 Very good data coverage. Indicator utilised in SDG Index for SDG 2	No	**Yes**; good data availability and the indicator is relevant to food security
64	Food (SDG 2)	Volume of production per labour unit by classes of farming/pastoral/forestry enterprise size	Volume of agricultural production of small-scale food producer in crop, livestock, fisheries, and forestry activities per number of days (UN Stats, 2018)	Not available	Volume/ production unit	None	Yes; indicator 2.3.1	No; there is no usable data available yet
65	Food (SDG 2)	Average income of small-scale food producers, by sex	measures income from on-farm production activities, which is related to the production of food and agricultural products. This includes income from crop	Not available	Annual income	None; data is still not available in a systematic and	Yes; indicator 2.3.2	No; there is no usable data available yet

[10] "According to the Engel's Law, the higher the income of a household, the lower the proportion of income spent on food. When applied at the National level, this indicator reflects the living standard of a country, as well as the vulnerability of a country to food price increases. Due to the lack/unreliability of income data, this indicator has been built as the ratio between food consumption and total consumption, hence using total consumption as a proxy income. Finally, given the higher vulnerability of the poorer households to food price increase, this indicator only encompasses the share of food consumption of the lowest income quintile of a country population" (http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk – *not available in latest update of downloadable data)

		and indigenous status	production, livestock production, fisheries and aquaculture production, and from forestry production. The indicator is computed as annual income (UN Stats, 2018)			harmonized fashion		
66	Food (SDG 2)	Proportion of agricultural area under productive and sustainable agriculture	measure both the extent of land under productive and sustainable agriculture, as well as the extent of land area under agriculture. Focuses on agricultural land, and therefore primarily on land that is used to grow crops and raise livestock (UN Stats, 2018)	Not available	Percentage	None	Yes; indicator 2.4.1	No, no data readily available
67	Food (SDG 2)	Number of plant and animal genetic resources for food and agriculture secured in either medium or long-term conservation facilities	The conservation of plant and animal genetic resources for food and agriculture (GRFA) in medium or long term conservation facilities (ex situ in genebanks) represents the most trusted means of conserving genetic resources worldwide. Plant and animal GRFA conserved in these facilities can be easily used in breeding programmes as well, even directly on-farm (UN Stats, 2018)	Not available yet, although data compilers have been appointed per country. http://www.fao.org/dad-is/sdg-251/en/	No. of species	None	Yes; indicator 2.5.1	No; there is no usable data available yet
68	Food (SDG 2)	Proportion of local breeds classified as being at risk, not-at-risk or at unknown level of risk of extinction	The indicator presents the percentage of livestock breeds classified as being at risk, not at risk or of unknown risk of extinctions at a certain moment in time, as well as the trends for those percentages (UN Stats, 2018)	http://www.fao.org/dad-is/dataexport/en/ Source: FAO	Percentage	Data collection dates are not specified. Data is available for various species per country.	Yes; indicator 2.5.2	No; although data is available per country, it seems like the data was only collected once as no sampling dates are specified
69	Food (SDG 2)	The agriculture orientation index for government expenditures	The Agriculture Orientation Index (AOI) for Government Expenditures is defined as the Agriculture Share of Government Expenditures, divided by the Agriculture Share of GDP, where Agriculture refers to the agriculture, forestry, fishing and hunting sector. The measure in a currency-free index, calculated as the ratio of these two shares. National governments are requested to compile Government Expenditures according to the international Classification of Functions of Government (COFOC), and Agriculture Share of GDP according to the System of National Accounts (SNA) (UN Stats, 2018)	http://www.fao.org/faostat/en/#data/IG/visualize Source: FAOSTAT	Percentage	Data can be calculated using government expenditure and GDP, but data specific for this indicator is not available.	Yes; indicator 2. a.1	No; although there is data per country available, it is fragmented. Further, it is not best practice to incorporate an index as part of another index.
70	Food (SDG 2)	Total official flows (official development assistance plus other official flows) to the agriculture sector	Gross disbursements of total ODA and other official flows from all donors to the agriculture sector (UN Stats, 2018)	Food aid: https://www.oecd-ilibrary.org/development/data/oecd-international-development-statistics/official-and-private-flows_data-00072-en	Million USD	Data is available from 1995-2017 for 35 countries with data missing for some years.	Yes; indicator 2. a.2	No; data is only available for 35 countries. The JRC-COIN guideline is that at an indicator level 65% of countries should have valid data.
71	Food (SDG 2)	Agricultural export subsidies	Agricultural export subsidies are defined as export subsidies budgetary outlays and quantities as notified by WTO Members in Tables ES:1 and supporting Tables ES:2 (following templates in document G/AG/2 dated 30 June 1995) (UN Stats, 2018)	https://www.wto.org/english/tratop_e/agric_e/transparency_toolkit_e.htm Source: World Trade Organization	Million USD	Data is available from 1995-2014 for 24 countries.	Yes; indicator 2. b.1	No; although it is important to consider financial flows of food export, this level of detail is not yet required in this WEF nexus framework

72	Food (SDG 2)	Indicator of food price anomalies	The indicator of food price anomalies (IFPA) identifies markets prices that are abnormally high. The IFPA relies on a weighted compound growth rate that accounts for both within year and across year price growth. The indicator directly evaluates growth in prices over a particular month over many years, taking into account seasonality in agricultural markets and inflation, allowing to answer the question of whether or not a change in price is abnormal for any particular period (UN Stats, 2018)	http://www.fao.org/giews/food-prices/tool/public/#/dataset/international	-	Data available for 2016 for 57 countries (specifically for rice; data also available for wheat, sorghum, maize, and millet)	Yes; indicator 2. c.1	No; data is difficult to manage as it does not download to an excel format. Further, it is not best practice to incorporate an index as part of another index.
73	Food (SDG 2)	Global food loss index	*No data for this indicator is currently available and its methodology is still under development (UN Stats, 2018)*	Not available yet	-	None	Yes; indicator 12.3.1	No; although this indicator is an SDG indicator it is not best practice to incorporate an index as part of another index.
74	Food (SDG 2)	Average value of food production	The indicator expresses the food net production value (in constant 2004-06 international dollars), as estimated by FAO and published by FAOSTAT, in per capita terms (FAO 2019-03-06)	http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.XIix_8t7lhG	I$ per caput	Data available from 1999-2014 for 201 countries.	No, but it is FAO indicator I_1.2	**Yes**; very good data coverage that includes data from 201 countries. The data can be used to infer priorities in terms of resource allocation in the WEF nexus.
75	Food (SDG 2)	Value of food imports over total merchandise exports	Value of food (excl. fish) imports over total merchandise exports (FAO 2019-03-06)	http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.XIix_8t7lhG	Percentage	Data available from 1999-2011 for 193 countries	No, but it is FAO indicator I_3.3	No, very good data coverage that includes data from 193 countries. However, there is a low correlation (<0.4) with other key indicators relating to food availability.
76	Food (SDG 2)	Agricultural machinery	Agricultural machinery refers to the number of wheel and crawler tractors (excluding garden tractors) in use in agriculture at the end of the calendar year specified or during the first quarter of the following year. Arable land includes land defined by the FAO as land under temporary crops (double-cropped areas are counted once), temporary meadows for mowing or for pasture, land under market or kitchen gardens, and land temporarily fallow. Land abandoned as a result of shifting cultivation is excluded (FAO: 2019-04-29)	https://data.worldbank.org/indicator/AG.LND.TRAC.ZS?view=chart Source: Food and Agriculture Organization, electronic files and web site	Tractors/ 100 km^2 of arable land	Data available from 1961-2009; for only 8 countries in 2009 but for approximately 164 countries in 1965	No	No, this indicator was measured widely up until 2000, and to some degree until 2008, but is no longer recorded.
77	Food (SDG 2)	Percent of arable land equipped for irrigation	Ratio between arable land equipped for irrigation and total arable land. Arable land is defined as the land under temporary agricultural crops (multiple-cropped areas are counted only once), temporary meadows for mowing or pasture, land under market and kitchen gardens and land temporarily fallow (less than five years). The abandoned land resulting from shifting cultivation is not included in this category. Data for arable land are	http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.XIix_8t7lhG Source: FAOSTAT and ESS calculations (11 Sep 2018)	%	Data available from 1999 to-2015 for 178 countries with missing data for some years.	No, but it is FAO indicator I_3.2	No, irrigation is a major user of water worldwide, and a key component of the WEF nexus, despite it having a poor correlation with some of the other indicators in food availability. This indicator has a negative correlation with the other indicators within

			not meant to indicate the amount of land that is potentially cultivable. Total arable land equipped for irrigation is defined as the area equipped to provide water (via irrigation) to the crops. It includes areas equipped for full and partial control irrigation, equipped lowland areas, pastures, and areas equipped for spate irrigation (FAO: 2019-04-29).					the "Access" sub-pillar of the "Food"sub-index, and is therefore excluded.
78	Food (SDG 2)	Agriculture, forestry and fishery, value added	Agriculture corresponds to ISIC divisions 1-5 and includes forestry, hunting, and fishing, as well as cultivation of crops and livestock production. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. The origin of value added is determined by the International Standard Industrial Classification (ISIC), revision 3. Note: This value is not specific to crop production, so care should be taken to ensure proper implementation.(FAO 2019-05-25)	https://data.worldbank.org/indicator/NV.AGR.TOTL.ZS **Source:** Food and Agriculture Organization, AQUASTAT data	% of GDP	Data available from 1966-2017 with many missing data per year. Most recent data are available for 2012 for 171 countries.	No	No, very good data availability and very relevant indicator regarding the value of land and water-based products/food to the economy, but low correlation with most indicators contributing to food availability
79	Food (SDG 2)	Electricity capacity in MW for renewable municipal waste	???	https://www.irena.org/Statistics/View-Data-by-Topic/Capacity-and-Generation/Technologies **Source**: Source: IRENA (2019), Renewable capacity statistics 2019; and IRENA (2018), Renewable Energy Statistics 2018, The International Renewable Energy Agency, Abu Dhabi.	MW	Data available from 2000-2018 with many missing data per country. Most recent data are available for 2018 for 41 countries.	No	No; data is only available for 41 countries. The JRC-COIN guideline is that at an indicator level 65% of countries should have valid data.
80	Food (SDG 2)	Electricity generation in GWh for renewable municipal waste	???	https://www.irena.org/Statistics/View-Data-by-Topic/Capacity-and-Generation/Technologies **Source**: Source: IRENA (2019), Renewable capacity statistics 2019; and IRENA (2018), Renewable Energy Statistics 2018, The International Renewable Energy Agency, Abu Dhabi.	GWh	Data available from 2000-2016 with many missing data per country. Most recent data are available for 2016 for 37 countries.	No	No; data is only available for 37 countries. The JRC-COIN guideline is that at an indicator level 65% of countries should have valid data.
81	Food (SDG 2)	Electricity capacity in MW for solid biofuel		https://www.irena.org/Statistics/View-Data-by-Topic/Capacity-and-Generation/Technologies **Source**: Source: IRENA (2019), Renewable capacity statistics 2019; and IRENA (2018), Renewable Energy Statistics 2018, The International Renewable Energy Agency, Abu Dhabi.	MW	Data available from 2000-2018 with many missing data per country. Most recent data are available for 2018 for 108 countries.	No	No, this data is included in the renewable energy consumption and output indicators
82	Food (SDG 2)	Electricity generation in GWh for solid biofuel		https://www.irena.org/Statistics/View-Data-by-Topic/Capacity-and-Generation/Technologies **Source**: Source: IRENA (2019), Renewable capacity statistics 2019; and IRENA (2018), Renewable Energy	GWh	Data available from 2000-2016 with many missing data per country. Most recent data are available for	No	No, this data is included in the renewable energy consumption and output indicators

				Statistics 2018, The International Renewable Energy Agency, Abu Dhabi.		2016 for 103 countries.		
83	Food (SDG 2)	Electricity capacity in MW for liquid biofuel		https://www.irena.org/Statistics/View-Data-by-Topic/Capacity-and-Generation/Technologies	MW	Data available from 2000-2018 with many missing data per country. Most recent data are available for 2018 for 14 countries.	No	No; data is only available for 14 countries. The JRC-COIN guideline is that at an indicator level 65% of countries should have valid data.
84	Food (SDG 2)	Electricity generation in GWh for liquid biofuel		**Source**: Source: IRENA (2019), Renewable capacity statistics 2019; and IRENA (2018), Renewable Energy Statistics 2018, The International Renewable Energy Agency, Abu Dhabi.	GWh	Data available from 2000-2016 with many missing data per country. Most recent data are available for 2016 for 17 countries.	No	No; data is only available for 17 countries. The JRC-COIN guideline is that at an indicator level 65% of countries should have valid data.
85	Food (SDG 2)	Alien invasive species	Area of agricultural land that has been encroached by alien invasive species, resulting is less arable land for food production and an increase in water consumption	Not available	Ha/year	None	No	No; there is no usable data available yet however it is important to consider alien invasive plant species as they affect food and water security
86	Food (SDG 2)	Proportion of countries adopting relevant national legislation and adequately resourcing the prevention or control of invasive alien species	Commitment by countries to relevant multinational agreements, specifically: (1) National adoption of invasive alien species-relevant international policy. (2) Percentage of countries with (a) national strategies for preventing and controlling invasive alien species; and (b) national legislation and policy relevant to invasive alien species. The translation of policy arrangements into action by countries to implement policy and actively prevent and control invasive alien species IAS and the resourcing of this action, specifically: (3) National allocation of resources towards the prevention or control of invasive alien species. (UN Stats, 2018)	Not available	%	None	Yes; indicator 15.8.1	No; there is no usable data available yet
87	Food (SDG 2)	Pests destroying crops [2]	Hectares of crops that are lost per year due to the invasion of pest species (armyworm, corn root worm etc) and diseases caused by fungi and bacteria (potato blight, coffee leaf rust etc)	Not available	Ha/year or kg/ha	None	No	No; there is no usable data available yet however it is important to consider pests as they are seen as the greatest threat to food security, and indirectly affects water security.

Addendum B: Untreated Indicator Data

Country		ind.01	ind.02	ind.03	ind.04	ind.05	ind.06	ind.07	ind.08	ind.09	ind.10	ind.11	ind.12	ind.13	ind.14	ind.15	ind.16	ind.17	ind.18	ind.19	ind.20	ind.21
		The percentage of people using at least basic drinking water services	Percentage of people using safely managed sanitation services.	Degree of IWRM implementation (1-100)	Annual freshwater withdrawals, total (% of internal resources)	Renewable internal freshwater resources per capita (cubic meters)	Environmental flow requirements (106 m3/annum)	Average precipitation in depth (mm per year)	Access to electricity (% of population)	Renewable energy consumption (% of total final energy consumption)	Renewable electricity output (% of total electricity output)	CO2 emissions (metric tons per capita)	Electric power consumption (kWh per capita)	Energy imports, net (% of energy use)	Prevalence of undernourishment (%)	Percentage of children under 5 years of age affected by wasting (%)	Percentage of children under 5 years of age who are stunted (%)	Prevalence of obesity in the adult population (18 years and older)	Average protein supply (gr/caput/day)	Cereal yield (kg per hectare)	Average Dietary Energy Supply Adequacy (ADESA) (%)	Average value of food production (I$ per caput)
Afghanistan	AFG	63.0	39.2	11.5	43.0	1439	28.3	327.0	84.1	18.4	86.1	0.3	n/a	n/a	30.3	9.5	40.9	4.5	33.0	1981.7	95.0	104.0
Albania	ALB	91.4	97.7	43.1	4.9	9311	13.6	1485.0	100.0	38.6	100.0	2.0	2309	13.8	5.5	9.4	23.1	22.3	104.0	4716.4	129.0	462.0
Algeria	DZA	93.5	87.5	48.2	69.4	288	4.6	89.0	99.4	0.1	0.3	3.7	1356	-177.1	4.7	4.1	11.7	26.6	75.0	1560.7	143.0	220.0
Angola	AGO	41.0	39.4	37.1	0.5	5498	110.7	1010.0	40.5	49.6	53.2	1.3	312	-541.0	23.9	4.9	37.6	6.8	52.0	934.7	108.0	137.0
Argentina	ARG	99.6	94.8	38.2	12.9	6794	515.8	591.0	100.0	10.0	28.1	4.7	3052	13.0	3.8	1.2	8.2	28.5	114.0	5096.5	135.0	1030.0
Armenia	ARM	98.9	91.6	35.9	42.9	2360	2.8	562.0	100.0	15.8	28.3	1.9	1966	71.3	4.3	4.2	9.4	20.9	91.0	3076.1	120.0	426.0
Australia	AUS	100.0	100.0	85.5	3.1	20932	243.3	534.0	100.0	9.2	13.6	15.4	10059	-190.2	1.2	0.8	2.0	30.4	150.0	2074.3	132.0	1009.0
Austria	AUT	100.0	100.0	91.1	6.3	6435	41.5	1110.0	100.0	34.4	76.5	6.9	8356	63.5	1.2	0.8	2.6	21.9	168.0	7245.2	148.0	472.0
Azerbaijan	AZE	84.4	89.3	66.0	147.5	851	12.0	447.0	100.0	2.3	7.0	3.9	2202	-310.4	1.2	3.1	18.0	19.9	58.0	3004.7	130.0	266.0
Bangladesh	BGD	97.3	46.9	50.0	34.2	659	600.3	2666.0	75.9	34.7	1.2	0.5	310	16.8	15.2	14.3	36.1	3.4	29.0	4628.9	109.0	138.0
Barbados	BRB	98.1	96.5	41.7	87.5	282	n/a	1422.0	100.0	2.8	n/a	4.5	n/a	n/a	3.7	6.8	7.7	24.8	88.0	2848.9	121.0	145.0
Belarus	BLR	98.0	94.3	38.1	4.5	3589	27.6	618.0	100.0	6.8	0.8	6.7	3680	86.8	1.2	2.2	4.5	26.6	131.0	3207.5	131.0	573.0
Belgium	BEL	100.0	99.5	77.5	50.0	1071	10.2	847.0	100.0	9.2	20.8	8.3	7709	80.1	1.2	0.8	2.6	24.5	163.0	6984.8	147.0	431.0
Belize	BLZ	97.1	87.2	19.9	0.7	43390	13.7	1705.0	92.2	35.0	45.2	1.4	n/a	n/a	6.5	1.8	15.0	22.4	75.0	3164.6	122.0	453.0
Benin	BEN	67.0	13.9	62.8	1.3	1001	13.1	1039.0	41.4	50.9	5.6	0.6	100	46.6	10.4	4.5	34.0	8.2	49.0	1455.9	123.0	214.0
Bhutan	BTN	97.6	62.9	32.4	0.4	100457	54.1	2200.0	100.0	86.9	100.0	1.3	n/a	n/a	n/a	5.9	33.6	5.8	n/a	3410.4	n/a	257.0
Bolivia	BOL	92.9	52.6	49.4	0.7	28735	396.6	1146.0	93.0	17.5	31.4	1.9	753	-178.0	19.8	2.0	n/a	18.7	52.0	2092.4	105.0	355.0
Bosnia and Herzegovina	BIH	97.7	94.8	60.9	0.9	9955	22.4	1028.0	100.0	40.8	35.5	6.2	3366	22.7	1.2	2.3	8.9	19.4	73.0	5191.7	128.0	252.0
Botswana	BWA	79.2	60.0	41.1	8.1	1107	2.7	416.0	60.7	28.9	0.0	3.2	1749	44.5	28.5	7.2	31.4	16.1	64.0	452.8	98.0	172.0
Brazil	BRA	97.5	86.1	50.7	1.3	27721	6532.0	1761.0	100.0	43.8	74.0	2.6	2601	11.9	1.2	1.6	7.1	22.3	116.0	4180.8	130.0	684.0

Brunei Darussalam	BRN	99.5	96.3	n/a	1.1	20646	5.8	2722.0	100.0	0.0	0.0	22.1	10243	-357.4	2.6	2.9	19.7	14.7	82.0	844.2	124.0	116.0
Bulgaria	BGR	99.3	86.0	60.2	27.2	2907	7.8	608.0	100.0	17.7	18.0	5.9	4709	36.6	3.0	3.2	8.8	27.4	94.0	4817.8	117.0	457.0
Burkina Faso	BFA	53.9	22.5	62.6	6.5	711	3.0	748.0	19.2	74.2	9.4	0.2	n/a	n/a	21.3	7.6	27.3	4.5	61.0	1181.4	122.0	122.0
Cabo Verde	CPV	86.5	65.2	n/a	6.8	570	n/a	228.0	92.6	26.6	20.2	0.9	n/a	n/a	12.3	n/a	n/a	10.6	69.0	178.0	113.0	73.0
Cambodia	KHM	75.0	48.8	45.6	1.8	7897	265.4	1904.0	49.8	64.9	46.4	0.4	271	33.1	18.5	9.6	32.4	3.5	34.0	3459.9	108.0	281.0
Cameroon	CMR	65.3	38.8	33.8	0.4	12275	213.4	1604.0	60.1	76.5	76.1	0.3	281	-28.3	7.3	5.2	31.7	9.5	56.0	1643.7	126.0	244.0
Canada	CAN	98.9	98.5	n/a	1.4	80202	1931.0	537.0	100.0	22.0	63.0	15.1	15546	-72.5	1.2	0.8	2.6	31.3	148.0	3908.8	140.0	746.0
Central African Republic	CAF	54.1	25.1	31.0	0.1	31227	119.4	1343.0	14.0	76.6	99.4	0.1	n/a	n/a	61.8	7.4	40.7	6.3	62.0	879.8	79.0	202.0
Chad	TCD	42.5	9.5	31.8	5.9	1105	25.2	322.0	8.8	89.4	n/a	0.1	n/a	n/a	39.7	13.0	39.9	4.8	47.0	844.7	98.0	154.0
Chile	CHL	100.0	99.9	22.6	4.0	50245	529.3	1522.0	100.0	24.9	43.6	4.7	3912	65.2	3.3	0.3	1.8	28.8	86.0	6858.2	125.0	455.0
China	CHN	n/a	n/a	74.5	21.3	2062	1471.0	645.0	100.0	12.4	23.9	7.5	3927	15.0	8.7	n/a	n/a	6.6	95.0	6029.2	131.0	379.0
Colombia	COL	96.5	84.4	50.4	0.5	44882	1692.0	3240.0	99.0	23.6	68.2	1.8	1290	-274.1	6.5	0.9	12.7	22.1	80.0	4191.8	127.0	282.0
Comoros	COM	83.7	34.2	25.7	0.8	1580	n/a	900.0	77.8	45.3	n/a	0.2	n/a	n/a	n/a	11.1	32.1	6.9	n/a	1355.8	105.0	90.0
Congo, Dem. Rep.	COD	41.8	19.7	31.3	0.1	12208	981.7	1543.0	17.1	95.8	99.8	0.1	109	2.0	n/a	8.1	n/a	5.6	n/a	771.5	n/a	51.0
Congo, Rep.	COG	68.3	15.0	32.0	0.0	45575	664.4	1646.0	56.6	62.4	53.3	0.6	197	-496.6	37.5	8.2	n/a	8.4	46.0	828.2	94.0	87.0
Costa Rica	CRI	99.7	97.1	43.3	2.1	23752	54.4	2926.0	100.0	38.7	99.0	1.6	1958	49.8	4.4	1.0	5.6	25.7	89.0	4027.0	119.0	634.0
Cote d'Ivoire	CIV	73.1	29.9	32.1	2.0	3410	61.3	1348.0	64.3	64.5	16.7	0.5	276	7.1	20.7	6.0	n/a	9.0	58.0	2133.9	119.0	271.0
Croatia	HRV	99.6	97.5	89.8	1.7	8895	60.5	1113.0	100.0	33.1	66.8	4.0	3714	45.9	1.2	0.8	2.6	27.1	112.0	6742.3	123.0	351.0
Cuba	CUB	95.2	90.8	80.4	18.3	3332	9.1	1335.0	100.0	19.3	3.9	3.0	1434	49.8	1.2	2.4	7.0	26.7	66.0	2939.3	147.0	254.0
Cyprus	CYP	100.0	99.4	90.7	28.4	677	0.0	498.0	100.0	9.9	8.8	5.3	3625	94.0	4.6	0.8	2.6	22.6	118.0	2191.0	108.0	269.0
Czech Republic	CZE	99.9	99.1	79.3	12.5	1249	6.6	677.0	100.0	14.8	11.4	9.2	6259	31.6	1.2	4.6	n/a	28.5	135.0	6317.3	128.0	347.0
Denmark	DNK	100.0	99.6	93.0	10.6	1063	2.3	703.0	100.0	33.2	65.5	5.9	5859	1.8	1.2	0.8	2.6	21.3	133.0	6222.0	132.0	1067.0
Djibouti	DJI	76.9	51.4	n/a	6.3	329	n/a	220.0	51.8	15.4	n/a	0.8	n/a	n/a	19.7	21.5	33.5	12.2	59.0	1925.6	108.0	78.0
Dominica	DMA	96.5	77.9	40.0	10.0	2748	n/a	2083.0	100.0	7.8	16.2	1.9	n/a	n/a	5.2	n/a	n/a	28.2	77.0	1696.2	122.0	371.0
Dominican Republic	DOM	94.5	82.7	35.5	30.4	2258	5.5	1410.0	100.0	16.5	11.6	2.1	1578	86.7	10.4	2.4	7.1	26.9	90.0	4761.1	114.0	291.0
Ecuador	ECU	92.6	86.1	41.8	2.2	27818	296.2	2274.0	99.9	13.8	52.8	2.8	1381	-114.7	7.8	1.6	23.9	19.3	93.0	3575.5	115.0	372.0
Egypt	EGY	98.4	93.2	40.3	4100.0	20	2.6	51.0	100.0	5.7	8.3	2.2	1658	-7.4	4.8	9.5	22.3	31.1	64.0	7114.0	152.0	238.0
El Salvador	SLV	93.0	91.1	21.3	13.6	2488	10.2	1784.0	98.6	24.4	57.8	1.0	939	49.2	10.3	2.1	13.6	22.7	59.0	2745.5	116.0	153.0
Estonia	EST	99.6	99.6	80.0	13.5	9669	3.6	626.0	100.0	27.5	14.4	14.8	6732	-2.7	2.8	n/a	2.6	23.8	91.0	2658.4	128.0	432.0
Ethiopia	ETH	39.1	7.1	31.3	6.4	1253	89.3	848.0	42.9	92.2	100.0	0.1	70	5.9	21.4	9.9	38.4	3.6	26.0	2484.0	105.0	114.0
Fiji	FJI	93.7	95.7	n/a	0.3	32231	n/a	2592.0	98.6	31.3	45.0	1.3	n/a	n/a	4.4	6.3	7.5	30.0	93.0	3017.8	124.0	218.0
Finland	FIN	100.0	99.4	74.6	6.1	19592	67.8	536.0	100.0	43.2	44.5	8.7	15250	45.3	1.2	0.8	2.6	24.9	138.0	3574.1	132.0	348.0
France	FRA	100.0	98.7	100.0	14.9	3016	96.8	867.0	100.0	13.5	15.9	4.6	6940	44.1	1.2	0.8	2.6	23.2	159.0	5686.8	140.0	597.0
Gabon	GAB	87.5	40.9	14.4	0.1	87433	138.3	1831.0	91.4	82.0	43.7	2.8	1173	-213.4	9.4	3.4	17.5	13.4	58.0	1604.0	124.0	136.0

Gambia, The	GMB	80.1	41.7	29.8	3.0	1564	3.4	836.0	47.8	51.5	n/a	0.3	n/a	n/a	9.6	11.1	n/a	8.7	72.0	840.7	120.0	68.0
Georgia	GEO	93.3	84.9	35.1	3.1	15597	32.6	1026.0	100.0	28.7	78.0	2.4	2688	68.8	7.4	1.6	11.3	23.3	64.0	2517.2	115.0	163.0
Germany	DEU	100.0	99.2	88.0	30.8	1321	81.0	700.0	100.0	14.2	29.2	8.9	7035	61.4	1.2	1.0	1.3	25.7	143.0	7182.1	137.0	415.0
Ghana	GHA	77.8	14.3	48.6	3.2	1124	33.3	1187.0	79.3	41.4	50.9	0.5	355	-8.2	6.1	4.7	18.8	9.7	46.0	1842.4	135.0	287.0
Greece	GRC	100.0	99.0	83.2	16.5	5325	19.0	652.0	100.0	17.2	28.7	6.2	5063	64.2	1.2	0.8	2.6	27.4	149.0	4144.8	135.0	592.0
Guatemala	GTM	93.6	67.4	24.9	3.0	6858	70.0	1996.0	91.8	63.7	60.4	1.2	578	32.8	15.8	0.7	46.5	18.8	56.0	2152.3	114.0	302.0
Guinea	GIN	67.4	22.0	24.1	0.2	19144	161.0	1651.0	33.5	76.3	78.8	0.2	n/a	n/a	19.7	8.1	32.4	6.6	61.0	1180.0	115.0	174.0
Guinea-Bissau	GNB	69.2	21.5	n/a	1.1	9271	19.7	1577.0	14.7	86.9	n/a	0.2	n/a	n/a	26.0	6.0	27.6	8.2	63.0	1426.4	102.0	213.0
Guyana	GUY	95.1	86.2	15.6	0.6	315696	227.2	2387.0	84.2	25.3	n/a	2.6	n/a	n/a	7.5	6.4	12.0	19.2	58.0	3516.0	121.0	545.0
Haiti	HTI	64.2	30.5	29.4	11.1	1231	3.2	1440.0	38.7	76.1	8.0	0.3	39	22.0	45.8	5.2	21.9	20.5	49.0	1012.7	96.0	135.0
Honduras	HND	92.2	79.8	20.5	1.8	10291	57.4	1976.0	87.6	51.5	42.3	1.1	630	53.0	15.3	1.4	22.7	19.4	72.0	1748.1	116.0	194.0
Hong Kong SAR, China	HKG	100.0	96.3	n/a	n/a	n/a	n/a	n/a	100.0	0.9	0.3	6.4	6083	98.7	1.2	0.8	n/a	n/a	136.0	2000.0	134.0	5.0
Hungary	HUN	100.0	98.0	73.3	84.2	608	46.1	589.0	100.0	15.6	10.6	4.3	3966	57.7	1.2	0.8	2.6	28.6	135.0	5099.2	120.0	549.0
Iceland	ISL	100.0	98.8	51.9	2.1	519265	96.4	1940.0	100.0	77.0	100.0	6.1	53832	11.6	1.2	n/a	2.6	23.1	148.0	n/a	136.0	344.0
India	IND	87.6	44.2	n/a	44.8	1118	937.1	1083.0	84.5	36.0	15.3	1.7	806	34.3	14.8	21.0	38.4	3.8	52.0	2992.8	108.0	186.0
Indonesia	IDN	89.5	67.9	48.2	5.6	7914	1269.0	2702.0	97.6	36.9	10.7	1.8	812	-103.1	7.7	13.5	36.4	6.9	56.0	5405.5	124.0	243.0
Iran, Islamic Rep.	IRN	94.9	88.3	59.0	72.5	1639	22.7	228.0	100.0	0.9	5.1	8.3	2986	-33.4	4.9	4.0	n/a	25.5	74.0	2166.4	131.0	318.0
Iraq	IRQ	86.1	85.7	25.1	187.5	1006	18.7	216.0	100.0	0.8	3.7	4.8	1306	-229.4	27.7	7.4	22.6	27.4	65.0	3100.6	111.0	53.0
Ireland	IRL	98.9	92.2	80.5	1.5	10520	31.2	1118.0	100.0	9.1	28.0	7.3	5672	85.7	1.2	n/a	2.6	26.9	128.0	8223.3	146.0	976.0
Israel	ISR	100.0	100.0	85.0	189.2	91	0.6	435.0	100.0	3.7	1.9	7.9	6601	65.0	1.2	0.8	2.6	26.7	150.0	4969.5	158.0	342.0
Italy	ITA	100.0	99.3	54.5	29.5	3002	77.8	832.0	100.0	16.5	38.7	5.3	5002	76.4	1.2	0.8	2.6	22.9	156.0	5599.0	142.0	471.0
Jamaica	JAM	92.9	85.4	42.9	7.5	3780	n/a	2051.0	98.2	16.8	10.3	2.6	1056	82.0	8.9	3.6	6.2	24.4	76.0	1090.1	113.0	192.0
Japan	JPN	98.9	100.0	93.9	18.9	3378	212.5	1668.0	100.0	6.3	16.0	9.5	7820	93.0	1.2	2.3	7.1	4.4	87.0	4975.5	113.0	133.0
Jordan	JOR	98.6	96.7	63.4	124.5	77	0.0	111.0	100.0	3.2	1.0	3.0	1888	96.8	13.5	2.4	7.8	33.4	100.0	1530.7	112.0	152.0
Kazakhstan	KAZ	91.1	97.8	30.2	31.0	3722	36.3	250.0	100.0	1.6	8.9	14.4	5600	-116.9	1.2	3.1	8.0	21.3	132.0	1347.7	138.0	430.0
Kenya	KEN	58.5	29.8	52.6	15.5	450	18.6	630.0	56.0	72.7	87.5	0.3	167	17.2	24.2	4.0	26.0	6.0	47.0	1390.7	101.0	149.0
Korea, Dem. People's Rep.	PRK	99.6	77.1	38.5	12.9	2668	45.9	1054.0	39.2	23.1	72.8	1.6	600	-74.8	43.4	4.0	n/a	7.1	35.0	4083.1	87.0	142.0
Korea, Rep.	KOR	99.6	99.9	67.9	44.8	1278	35.4	1274.0	100.0	2.7	1.9	11.6	10497	81.4	1.2	1.2	n/a	4.9	103.0	6795.2	135.0	202.0
Kuwait	KWT	100.0	100.0	81.5	n/a	3	n/a	121.0	100.0	n/a	n/a	25.2	15213	-391.1	1.2	3.1	4.9	37.0	115.0	13345	141.0	90.0
Lao PDR	LAO	80.4	72.6	n/a	1.8	28952	180.1	1834.0	87.1	59.3	86.4	0.3	n/a	n/a	16.6	6.4	n/a	4.5	37.0	4626.7	106.0	355.0
Latvia	LVA	98.6	92.9	64.3	1.4	8496	18.0	641.0	100.0	38.1	50.2	3.5	3507	45.2	1.2	n/a	2.6	25.7	118.0	3828.4	129.0	471.0
Lebanon	LBN	92.3	95.4	32.2	22.8	857	1.4	661.0	100.0	3.6	2.6	4.3	2893	97.9	10.9	6.6	16.5	31.3	102.0	3013.2	114.0	186.0
Lesotho	LSO	71.6	43.8	32.9	0.8	2437	1.3	788.0	29.7	52.1	100.0	1.2	n/a	n/a	12.8	2.8	33.2	13.5	32.0	508.3	114.0	73.0
Liberia	LBR	69.9	16.9	15.0	0.1	45550	176.8	2391.0	19.8	83.8	n/a	0.2	n/a	n/a	38.8	5.6	32.1	8.6	60.0	1322.3	101.0	74.0

Libya	LBY	96.8	99.7	46.9	822.9	113	n/a	56.0	98.5	2.0	n/a	9.2	1857	-103.0	n/a	6.5	21.0	31.8	n/a	715.0	140.0	181.0
Lithuania	LTU	97.4	93.6	56.6	4.1	5272	10.6	656.0	100.0	29.0	39.4	4.4	3821	75.0	1.2	n/a	2.6	28.4	96.0	3853.0	138.0	675.0
Luxembourg	LUX	100.0	97.6	90.2	4.3	1798	2.3	934.0	100.0	9.0	32.4	17.4	13915	96.3	1.2	0.8	2.6	24.2	139.0	4999.6	138.0	343.0
Macedonia, FYR	MKD	96.8	90.9	n/a	10.2	2599	n/a	619.0	100.0	24.2	35.9	3.6	3497	51.8	4.1	1.8	n/a	23.9	102.0	3858.8	118.0	371.0
Madagascar	MDG	50.6	9.7	36.5	4.0	14286	217.5	1513.0	22.9	70.2	54.6	0.1	n/a	n/a	43.1	15.2	49.2	4.5	24.0	3920.3	89.0	137.0
Malawi	MWI	67.2	43.5	40.3	8.4	946	9.5	1181.0	11.0	83.6	91.3	0.1	n/a	n/a	26.3	2.7	37.1	4.7	39.0	1347.4	104.0	139.0
Malaysia	MYS	96.4	99.6	42.8	1.9	19187	385.0	2875.0	100.0	5.2	10.0	8.0	4596	-5.5	2.9	11.5	20.7	15.3	88.0	3226.5	125.0	470.0
Maldives	MDV	97.9	95.9	35.5	15.7	73	n/a	1972.0	100.0	1.0	1.3	3.3	n/a	n/a	11.0	10.2	20.3	7.9	62.0	2445.9	115.0	18.0
Mali	MLI	74.3	31.3	53.3	8.6	3537	55.2	282.0	35.1	61.5	43.5	0.1	n/a	n/a	6.0	13.5	30.4	7.1	62.0	1607.5	142.0	244.0
Malta	MLT	100.0	100.0	75.3	44.4	116	n/a	560.0	100.0	5.4	7.7	5.4	4925	98.4	1.2	0.8	2.6	31.0	115.0	4744.9	134.0	169.0
Mauritania	MRT	69.6	44.6	45.4	337.0	98	1.2	92.0	41.7	32.2	13.4	0.7	n/a	n/a	11.3	14.8	27.9	11.3	78.0	1221.6	126.0	153.0
Mauritius	MUS	99.9	93.1	64.4	26.4	2182	n/a	2041.0	98.8	11.5	22.7	3.4	2183	84.5	5.8	n/a	n/a	11.5	92.0	3455.0	125.0	190.0
Mexico	MEX	98.3	89.2	49.5	20.0	3293	195.3	758.0	100.0	9.2	15.4	3.9	2090	-4.7	3.8	1.0	12.4	28.4	92.0	3748.8	132.0	293.0
Moldova	MDA	86.7	78.4	n/a	65.7	456	5.5	450.0	100.0	14.3	5.4	1.4	1386	90.0	n/a	1.9	n/a	20.1	85.0	3196.7	105.0	314.0
Mongolia	MNG	83.2	59.2	43.0	1.6	11902	21.2	241.0	81.8	3.4	3.1	7.1	2018	-168.1	18.7	1.0	10.8	19.6	88.0	1279.4	106.0	315.0
Montenegro	MNE	97.6	95.9	34.4	n/a	n/a	n/a	241.0	100.0	43.0	49.7	3.6	4612	27.6	1.2	2.8	9.4	24.9	129.0	3261.7	141.0	156.0
Morocco	MAR	83.0	83.5	63.9	35.7	845	8.2	346.0	100.0	11.3	14.3	1.7	901	90.7	3.9	2.3	14.9	25.6	68.0	936.2	147.0	250.0
Mozambique	MOZ	47.3	23.6	54.6	0.9	3686	133.0	1032.0	24.2	86.4	86.4	0.3	463	-54.6	30.5	6.1	43.1	6.0	41.0	823.8	106.0	97.0
Myanmar	MMR	67.5	64.7	27.3	3.3	19317	595.0	2091.0	57.0	61.5	58.9	0.4	217	-33.0	10.5	7.0	29.2	5.7	70.0	3607.4	118.0	323.0
Namibia	NAM	n/a	n/a	59.1	4.6	2598	7.2	285.0	51.8	26.5	97.8	1.6	1585	74.4	25.4	n/a	n/a	15.0	49.0	453.1	98.0	168.0
Nepal	NPL	87.7	46.1	32.9	4.8	6998	95.9	1500.0	90.7	85.3	100.0	0.3	139	16.7	9.5	9.7	35.8	3.8	53.0	2605.4	118.0	203.0
Netherlands	NLD	100.0	97.7	93.2	97.5	652	38.3	778.0	100.0	5.9	12.4	9.9	6713	35.0	1.2	0.8	2.6	23.1	124.0	7776.9	125.0	810.0
New Zealand	NZL	100.0	100.0	57.6	1.6	72510	204.3	1732.0	100.0	30.8	80.1	7.7	9026	19.5	1.2	0.8	2.6	32.0	117.0	8383.8	123.0	2425.0
Nicaragua	NIC	82.3	76.3	n/a	1.0	25973	107.2	2280.0	81.8	48.2	50.1	0.8	580	40.9	16.2	2.2	17.3	21.8	60.0	1768.0	117.0	238.0
Niger	NER	45.8	12.9	49.7	28.1	183	10.6	151.0	16.2	78.9	0.8	0.1	51	-5.8	14.4	10.3	42.2	4.7	55.0	530.3	123.0	180.0
Nigeria	NGA	67.3	32.6	35.1	5.6	1252	157.2	1150.0	59.3	86.6	18.2	0.5	144	-93.0	11.5	10.8	43.6	7.8	57.0	1443.6	117.0	211.0
Norway	NOR	100.0	98.1	63.4	0.8	74359	261.5	1414.0	100.0	57.8	97.7	9.3	23000	-581.3	1.2	0.8	2.6	25.0	150.0	4607.8	136.0	260.0
Oman	OMN	90.9	99.3	33.2	84.7	353	n/a	125.0	100.0	n/a	n/a	15.4	6554	-206.2	5.4	7.5	14.1	22.9	87.0	5689.9	125.0	114.0
Pakistan	PAK	88.5	58.3	49.8	333.6	296	83.8	494.0	99.1	46.5	31.4	0.9	471	24.1	20.5	10.5	45.0	7.8	74.0	3064.2	108.0	196.0
Panama	PAN	95.0	76.9	36.7	0.8	34990	4.9	2928.0	93.4	21.2	65.3	2.3	2063	80.9	9.2	1.2	19.1	22.5	76.0	2569.7	122.0	238.0
Papua New Guinea	PNG	36.6	18.6	25.0	0.0	103278	504.5	3142.0	22.9	52.5	34.5	0.8	n/a	n/a	n/a	14.3	49.5	19.4	n/a	4737.8	100.0	351.0
Paraguay	PRY	98.9	91.2	31.9	2.1	17856	256.3	1130.0	98.4	61.7	100.0	0.9	1564	-36.9	11.2	1.0	5.6	19.0	92.0	4425.5	111.0	855.0
Peru	PER	89.9	76.8	29.6	0.8	52981	1343.0	1738.0	94.9	25.5	52.7	2.0	1308	-14.9	8.8	1.0	13.1	19.1	50.0	4187.7	117.0	292.0
Philippines	PHL	90.5	75.0	51.0	17.0	4785	151.9	2348.0	91.0	27.5	25.4	1.1	699	45.8	13.7	7.1	33.4	6.0	52.0	3529.0	117.0	196.0

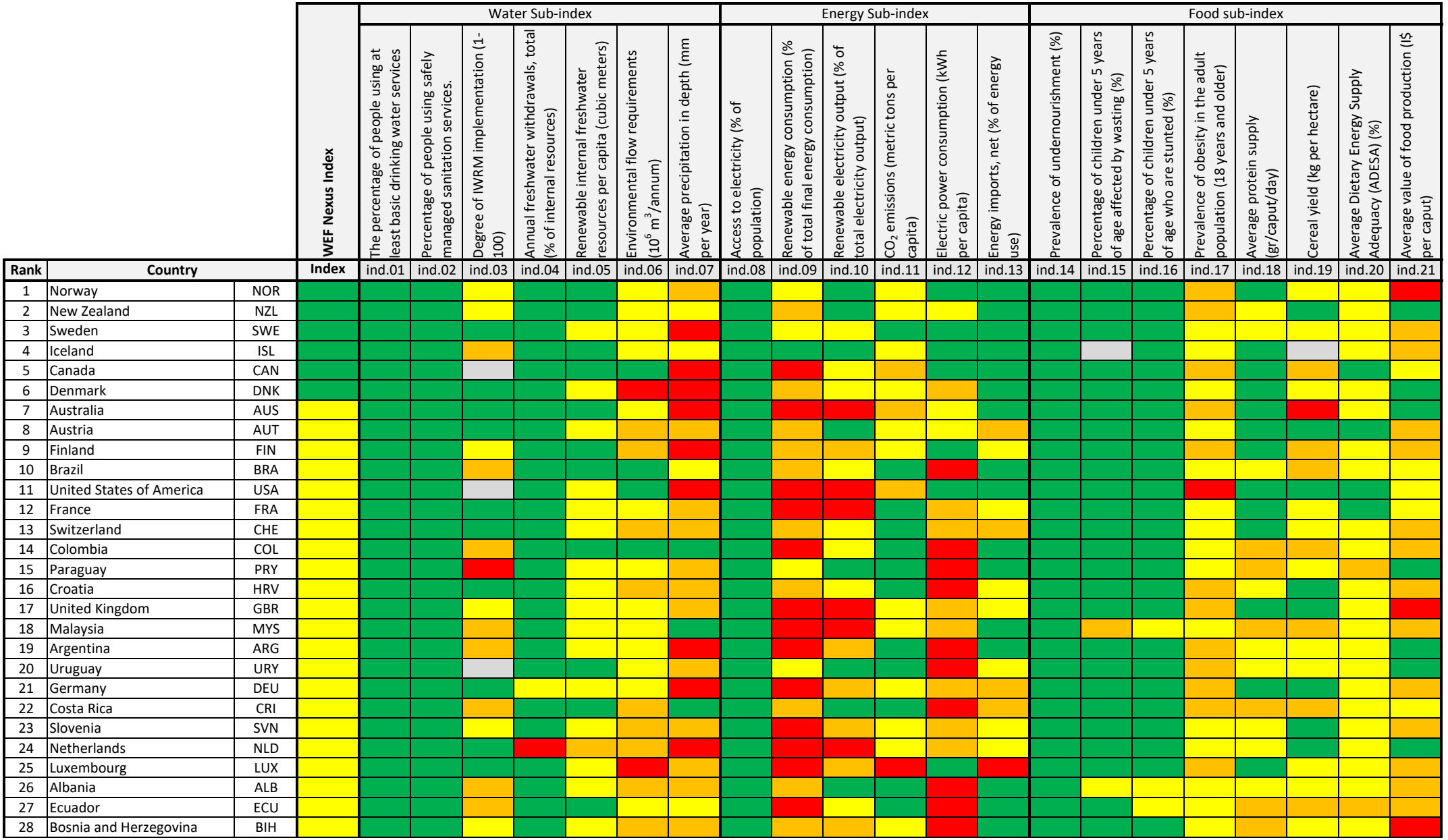
Poland	POL	97.9	98.1	39.5	21.4	1410	31.6	600.0	100.0	11.9	13.8	7.5	3972	28.5	1.2	0.8	2.6	25.6	118.0	3999.9	137.0	491.0
Portugal	PRT	99.9	99.4	74.1	24.1	3653	27.6	854.0	100.0	27.2	47.5	4.3	4663	76.9	1.2	0.8	2.6	23.2	140.0	4422.4	139.0	420.0
Qatar	QAT	100.0	100.0	82.2	387.5	24	n/a	74.0	100.0	n/a	n/a	45.4	15309	-399.0	n/a	0.8	2.6	33.9	n/a	4692.7	n/a	26.0
Romania	ROU	100.0	81.8	72.5	15.1	2129	105.2	637.0	100.0	23.7	39.7	3.5	2584	16.8	1.2	3.5	12.8	24.5	103.0	3971.2	135.0	483.0
Russian Federation	RUS	96.4	88.8	79.0	1.4	29982	2953.0	460.0	100.0	3.3	15.9	11.9	6603	-83.7	1.2	n/a	n/a	25.7	103.0	2650.4	138.0	327.0
Rwanda	RWA	56.7	62.3	34.7	1.6	837	10.3	1212.0	29.4	86.7	56.9	0.1	n/a	n/a	36.1	2.2	37.9	4.8	26.0	1522.5	100.0	209.0
Samoa	WSM	95.5	96.6	69.9	n/a	n/a	n/a	1583.0	100.0	34.3	30.4	1.0	n/a	n/a	3.1	3.7	4.7	45.5	138.0	n/a	129.0	290.0
Sao Tome and Principe	STP	79.7	40.1	22.8	0.3	11398	n/a	3200.0	65.4	41.1	10.5	0.6	n/a	n/a	10.2	4.0	17.2	10.6	76.0	2098.4	113.0	147.0
Saudi Arabia	SAU	100.0	100.0	56.7	943.3	78	n/a	59.0	100.0	0.0	0.0	19.5	9444	-191.5	5.5	11.8	9.3	35.0	103.0	5243.3	135.0	103.0
Senegal	SEN	75.2	48.4	53.3	8.6	1774	20.2	686.0	64.5	42.7	10.4	0.6	223	52.7	11.3	7.2	17.0	7.4	72.0	1349.0	111.0	103.0
Serbia	SRB	91.2	94.6	29.9	49.4	1179	73.5	686.0	100.0	21.2	26.9	5.3	4272	28.8	5.6	3.9	6.0	23.5	78.0	6173.5	110.0	392.0
Sierra Leone	SLE	58.1	14.5	18.6	0.1	22602	117.2	2526.0	20.3	77.7	61.0	0.2	n/a	n/a	25.5	9.4	37.9	7.5	57.0	1889.1	109.0	177.0
Singapore	SGP	100.0	100.0	100.0	31.7	110	n/a	2497.0	100.0	0.7	1.8	10.3	8845	97.7	n/a	3.6	4.4	6.6	n/a	n/a	n/a	5.0
Slovak Republic	SVK	97.9	98.9	65.8	4.4	2325	26.9	824.0	100.0	13.4	22.7	5.7	5137	60.7	2.7	0.8	n/a	22.4	112.0	6430.4	119.0	284.0
Slovenia	SVN	99.5	99.1	57.9	6.2	9054	17.1	1162.0	100.0	20.9	29.4	6.2	6728	48.5	1.2	0.8	2.6	22.5	119.0	6464.4	127.0	313.0
Solomon Islands	SLB	64.0	31.3	25.8	n/a	77671	n/a	3028.0	47.9	63.3	2.3	0.4	n/a	n/a	12.3	7.9	31.6	20.5	48.0	1657.0	113.0	202.0
South Africa	ZAF	84.7	73.1	65.5	34.6	821	20.1	495.0	84.2	17.2	2.3	9.0	4198	-14.5	6.1	2.5	27.4	27.0	83.0	3809.5	123.0	229.0
South Sudan	SSD	50.4	10.4	38.3	2.5	2255	33.9	900.0	8.9	39.1	0.6	0.1	40	-1058	n/a	22.7	31.1	n/a	n/a	1511.8	n/a	146.0
Spain	ESP	99.9	99.9	82.5	33.0	2392	38.2	636.0	100.0	16.3	34.9	5.0	5356	71.4	1.2	0.8	2.6	n/a	n/a	3430.3	n/a	657.0
Sri Lanka	LKA	92.3	94.2	25.3	24.5	2542	38.5	1712.0	95.6	52.9	48.5	0.9	531	50.3	10.9	15.1	17.3	5.4	48.0	3897.4	112.0	121.0
Sudan	SDN	58.9	34.6	39.9	673.3	102	15.1	250.0	38.5	61.6	64.5	0.3	190	-9.0	25.2	16.3	38.2	7.4	69.0	684.8	106.0	163.0
Suriname	SUR	94.7	79.2	15.1	0.6	180681	83.4	2331.0	87.2	24.9	60.1	3.6	3632	-43.8	7.6	5.0	8.8	26.5	80.0	4433.0	117.0	248.0
Eswatini	SWZ	67.6	58.0	52.6	39.5	2038	3.1	788.0	65.8	66.1	46.6	0.9	n/a	n/a	20.7	2.0	n/a	13.5	44.0	1138.1	103.0	237.0
Sweden	SWE	100.0	99.3	88.5	1.6	17636	104.7	624.0	100.0	53.2	63.3	4.5	13480	24.7	1.2	0.8	2.6	22.1	132.0	5438.2	126.0	290.0
Switzerland	CHE	100.0	99.9	81.4	5.0	4934	27.3	1537.0	100.0	25.3	62.2	4.3	7520	50.1	1.2	0.8	2.6	21.2	154.0	5132.6	131.0	306.0
Syrian Arab Republic	SYR	96.7	92.9	n/a	198.3	371	5.6	252.0	100.0	0.5	2.3	1.6	950	47.8	n/a	11.5	27.5	25.8	n/a	1614.7	134.0	255.0
Tajikistan	TJK	74.1	95.5	n/a	17.6	7588	6.8	691.0	100.0	44.7	98.5	0.6	1480	36.2	n/a	9.9	26.8	12.6	59.0	3348.7	97.0	142.0
Tanzania	TZA	50.1	23.5	n/a	6.2	1608	56.3	1071.0	32.8	85.7	34.2	0.2	99	10.7	32.0	4.5	n/a	4.1	46.0	1540.7	106.0	193.0
Thailand	THA	98.2	95.0	n/a	25.5	3281	189.6	1622.0	100.0	22.9	8.5	4.6	2540	41.6	9.0	5.4	10.5	10.8	59.0	3031.8	114.0	386.0
Timor-Leste	TLS	70.2	44.0	14.1	14.3	6774	4.1	1500.0	63.4	18.2	n/a	0.4	n/a	n/a	27.2	11.0	50.2	2.9	48.0	2454.4	102.0	96.0
Togo	TGO	62.8	13.9	31.9	1.5	1591	8.1	1168.0	46.9	71.3	75.3	0.4	153	20.0	16.2	6.7	27.5	7.1	49.0	1131.4	114.0	122.0
Trinidad and Tobago	TTO	96.9	92.1	25.0	8.8	2835	2.2	2200.0	100.0	0.3	n/a	34.2	7134	-102.7	4.9	6.3	11.0	19.7	89.0	1480.9	129.0	103.0
Tunisia	TUN	94.2	93.1	54.5	76.7	376	0.7	207.0	100.0	12.6	2.8	2.6	1444	36.2	4.9	2.8	10.1	27.3	90.0	1541.7	142.0	358.0
Turkey	TUR	98.9	96.4	69.5	18.5	2947	77.0	593.0	100.0	13.4	32.0	4.5	2855	75.2	1.2	1.7	9.5	32.2	120.0	3105.4	158.0	484.0

Turkmenistan	TKM	94.5	96.6	n/a	1983.6	257	5.4	161.0	100.0	0.0	n/a	12.5	2679	-191.5	5.5	4.2	11.5	17.5	83.0	1075.6	121.0	325.0
Uganda	UGA	38.9	19.2	58.7	1.6	1004	49.2	1180.0	26.7	89.1	93.0	0.1	n/a	n/a	41.4	3.6	28.9	7.1	47.0	1906.2	95.0	120.0
Ukraine	UKR	97.7	95.9	38.9	27.0	1217	98.1	565.0	100.0	4.1	4.4	5.0	3419	27.2	3.3	8.2	22.9	26.1	91.0	4652.4	119.0	589.0
United Arab Emirates	ARE	99.6	100.0	74.9	1866.7	17	n/a	78.0	100.0	0.1	0.2	23.3	11264	-183.8	1.2	0.8	2.6	29.9	88.0	21487	126.0	66.0
United Kingdom	GBR	100.0	99.1	76.7	5.5	2244	88.4	1220.0	100.0	8.7	24.8	6.5	5130	34.6	1.2	0.8	2.6	29.5	138.0	7022.6	138.0	259.0
United States of America	USA	99.2	100.0	n/a	14.9	8844	1491.0	715.0	100.0	8.7	13.2	16.5	12984	7.3	1.2	0.5	2.1	37.3	161.0	8142.9	147.0	704.0
Uruguay	URY	99.2	95.7	n/a	4.0	26963	134.8	1300.0	100.0	58.0	88.6	2.0	3068	44.4	1.2	1.3	10.7	28.9	103.0	4940.5	133.0	1152.0
Uzbekistan	UZB	91.5	100.0	45.2	300.9	531	14.0	206.0	100.0	3.0	20.7	3.4	1645	-26.2	7.4	4.5	19.6	15.3	72.0	4613.1	115.0	321.0
Vanuatu	VUT	90.5	53.5	38.9	n/a	38632	n/a	206.0	57.8	36.1	21.3	0.6	n/a	n/a	7.1	4.4	28.5	23.5	104.0	612.5	128.0	279.0
Venezuela, RB	VEN	97.4	94.9	n/a	2.8	26189	1025.0	2044.0	99.6	12.8	63.7	6.0	2658	-178.8	11.7	4.1	n/a	25.2	84.0	3426.9	105.0	201.0
Vietnam	VNM	91.2	78.2	37.7	22.8	3884	432.6	1821.0	100.0	35.0	36.7	1.8	1411	-15.1	10.8	6.4	n/a	2.1	71.0	5448.0	123.0	300.0
Yemen, Rep.	YEM	70.4	59.7	n/a	168.6	80	n/a	167.0	71.6	2.3	n/a	0.9	216	-120.6	34.4	16.3	n/a	14.1	45.0	995.3	95.0	65.0
Zambia	ZMB	61.2	31.1	46.1	2.0	5134	49.4	1020.0	27.2	88.0	97.0	0.3	707	8.3	44.5	6.3	40.0	6.5	41.0	2418.0	93.0	118.0
Zimbabwe	ZWE	66.6	38.6	61.0	29.1	796	9.3	657.0	38.1	81.8	52.7	0.8	537	15.3	46.6	3.2	26.8	12.3	58.0	580.0	87.0	75.0

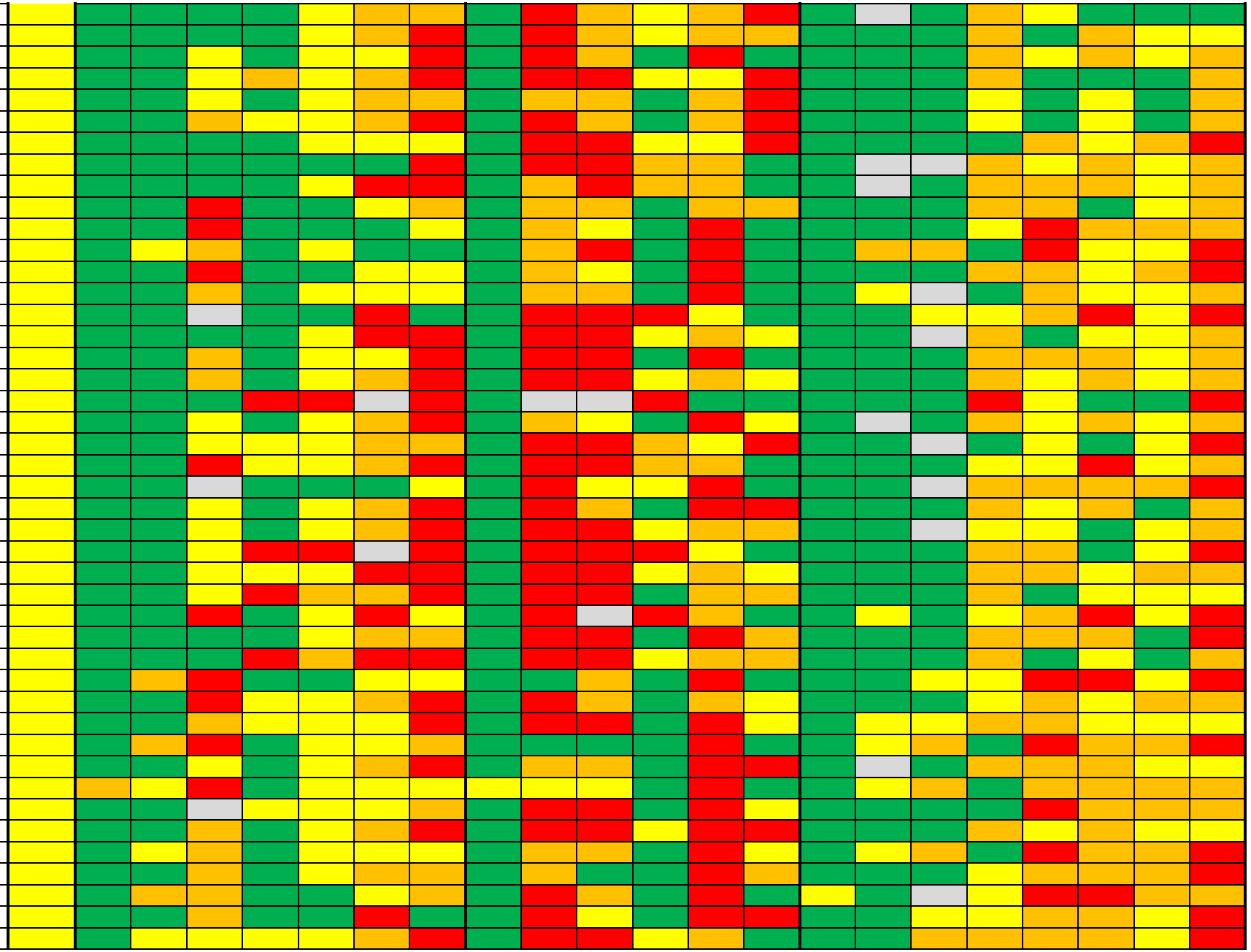
Addendum C: Conceptual Framework of WEF Nexus Index composition

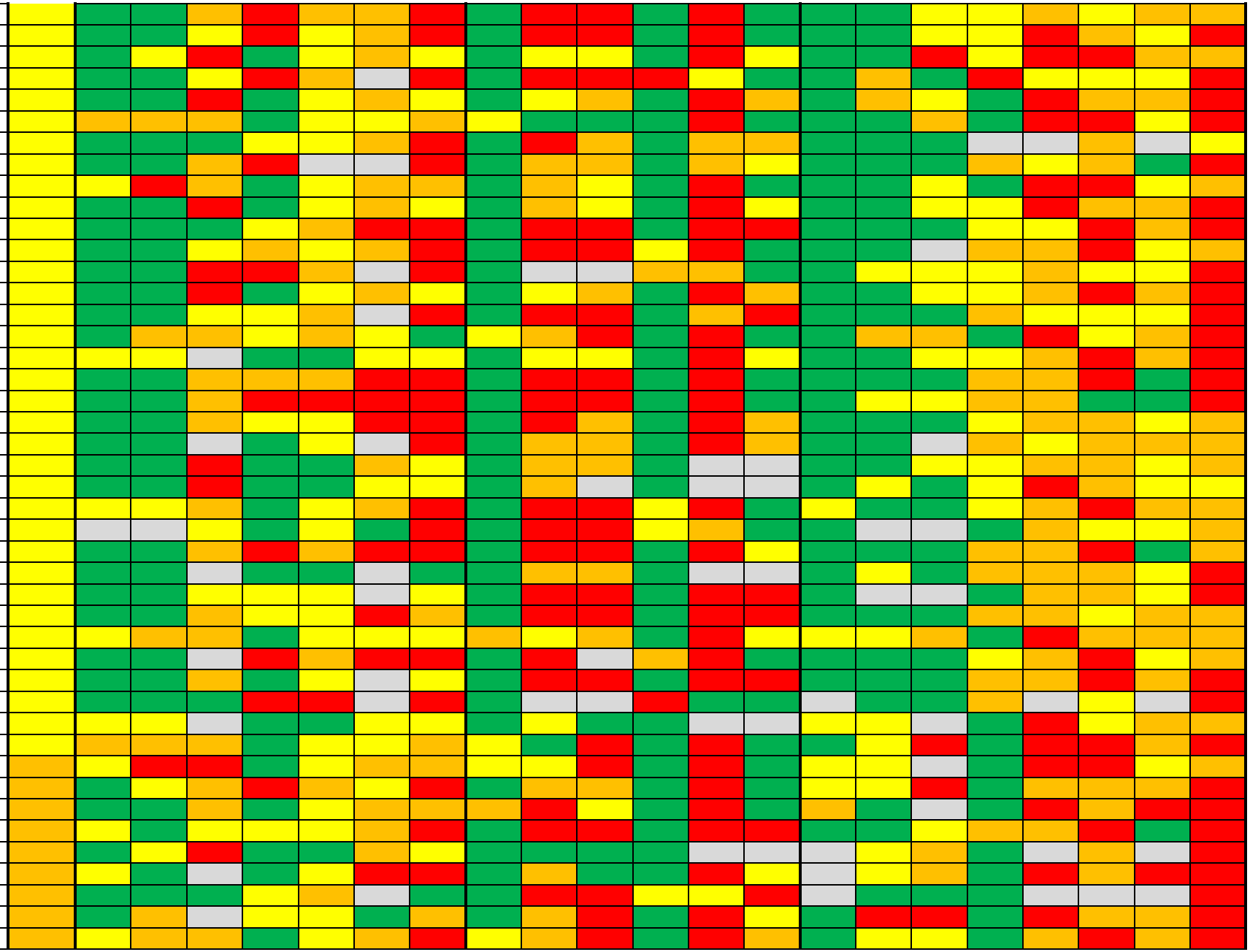
Item	Dimension/indicator	Supra-dimension	Weight	Aggregation	Direction	Name of dimension/indicator
Index	Index		1	Arithmetic	1	Water-Energy-Food Nexus Index
Pillars	p.01	si.01	0.333	Arithmetic	1	Water sub-index
	p.02	si.01	0.333	Arithmetic	1	Energy sub-index
	p.03	si.01	0.333	Arithmetic	1	Food sub-index
Sub-pillars	sp.01	p.01	0.5	Arithmetic	1	Access
	sp.02	p.01	0.5	Arithmetic	1	Availability
	sp.03	p.02	0.5	Arithmetic	1	Access
	sp.04	p.02	0.5	Arithmetic	1	Availability
	sp.05	p.03	0.5	Arithmetic	1	Access
	sp.06	p.03	0.5	Arithmetic	1	Availability
Indicators	ind.01	sp.01	0.333	Arithmetic	1	The percentage of people using at least basic drinking water services
	ind.02	sp.01	0.333	Arithmetic	1	Percentage of people using safely managed sanitation services.
	ind.03	sp.01	0.333	Arithmetic	1	Degree of IWRM implementation (1-100)
	ind.04	sp.02	0.25	Arithmetic	-1	Annual freshwater withdrawals, total (% of internal resources)
	ind.05	sp.02	0.25	Arithmetic	1	Renewable internal freshwater resources per capita (cubic meters)
	ind.06	sp.02	0.25	Arithmetic	1	Environmental flow requirements (106 m3/annum)
	ind.07	sp.02	0.25	Arithmetic	1	Average precipitation in depth (mm per year)
	ind.08	sp.03	0.5	Arithmetic	1	Access to electricity (% of population)
	ind.09	sp.03	0.167	Arithmetic	1	Renewable energy consumption (% of total final energy consumption)
	ind.10	sp.03	0.167	Arithmetic	1	Renewable electricity output (% of total electricity output)
	ind.11	sp.03	0.167	Arithmetic	-1	CO2 emissions (metric tons per capita)
	ind.12	sp.04	0.5	Arithmetic	1	Electric power consumption (kWh per capita)
	ind.13	sp.04	0.5	Arithmetic	-1	Energy imports, net (% of energy use)
	ind.14	sp.05	0.333	Arithmetic	-1	Prevalence of undernourishment (%)
	ind.15	sp.05	0.167	Arithmetic	-1	Percentage of children under 5 years of age affected by wasting (%)
	ind.16	sp.05	0.167	Arithmetic	-1	Percentage of children under 5 years of age who are stunted (%)
	ind.17	sp.05	0.333	Arithmetic	-1	Prevalence of obesity in the adult population (18 years and older)
	ind.18	sp.06	0.25	Arithmetic	1	Average protein supply (gr/caput/day)
	ind.19	sp.06	0.25	Arithmetic	1	Cereal yield (kg per hectare)
	ind.20	sp.06	0.25	Arithmetic	1	Average Dietary Energy Supply Adequacy (ADESA) (%)
	ind.21	sp.06	0.25	Arithmetic	1	Average value of food production (I$ per caput)

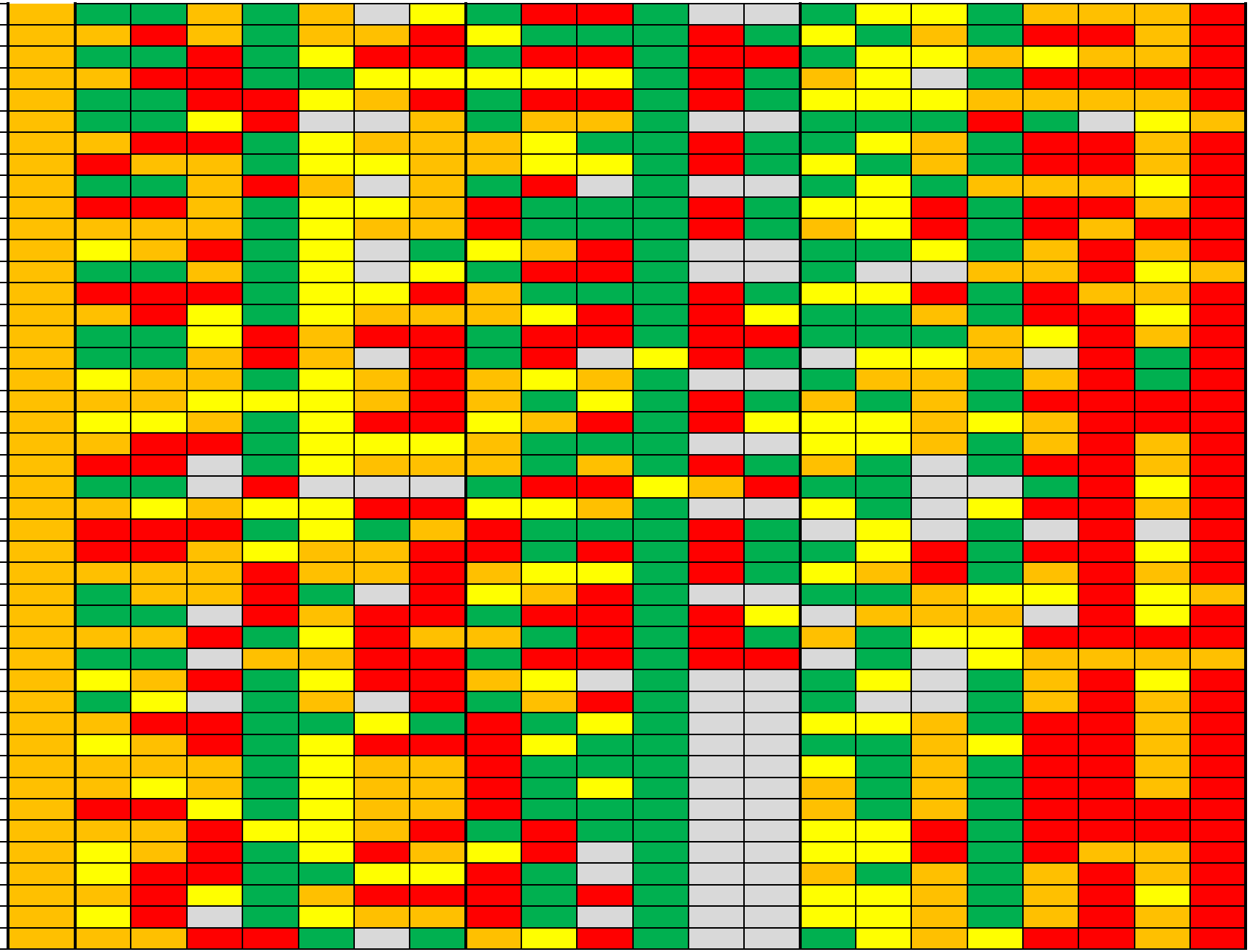
Addendum D: WEF Nexus Index Dashboard



				Water Sub-index							Energy Sub-index						Food sub-index							
			WEF Nexus Index	The percentage of people using at least basic drinking water services	Percentage of people using safely managed sanitation services.	Degree of IWRM implementation (1-100)	Annual freshwater withdrawals, total (% of internal resources)	Renewable internal freshwater resources per capita (cubic meters)	Environmental flow requirements (10^6 m^3/annum)	Average precipitation in depth (mm per year)	Access to electricity (% of population)	Renewable energy consumption (% of total final energy consumption)	Renewable electricity output (% of total electricity output)	CO_2 emissions (metric tons per capita)	Electric power consumption (kWh per capita)	Energy imports, net (% of energy use)	Prevalence of undernourishment (%)	Percentage of children under 5 years of age affected by wasting (%)	Percentage of children under 5 years of age who are stunted (%)	Prevalence of obesity in the adult population (18 years and older)	Average protein supply (gr/caput/day)	Cereal yield (kg per hectare)	Average Dietary Energy Supply Adequacy (ADESA) (%)	Average value of food production (I$ per caput)
Rank	**Country**		**Index**	ind.01	ind.02	ind.03	ind.04	ind.05	ind.06	ind.07	ind.08	ind.09	ind.10	ind.11	ind.12	ind.13	ind.14	ind.15	ind.16	ind.17	ind.18	ind.19	ind.20	ind.21
1	Norway	NOR																						
2	New Zealand	NZL																						
3	Sweden	SWE																						
4	Iceland	ISL																						
5	Canada	CAN																						
6	Denmark	DNK																						
7	Australia	AUS																						
8	Austria	AUT																						
9	Finland	FIN																						
10	Brazil	BRA																						
11	United States of America	USA																						
12	France	FRA																						
13	Switzerland	CHE																						
14	Colombia	COL																						
15	Paraguay	PRY																						
16	Croatia	HRV																						
17	United Kingdom	GBR																						
18	Malaysia	MYS																						
19	Argentina	ARG																						
20	Uruguay	URY																						
21	Germany	DEU																						
22	Costa Rica	CRI																						
23	Slovenia	SVN																						
24	Netherlands	NLD																						
25	Luxembourg	LUX																						
26	Albania	ALB																						
27	Ecuador	ECU																						
28	Bosnia and Herzegovina	BIH																						

29	Ireland	IRL	
30	Greece	GRC	
31	Romania	ROU	
32	Belgium	BEL	
33	Portugal	PRT	
34	Italy	ITA	
35	Japan	JPN	
36	Russian Federation	RUS	
37	Estonia	EST	
38	Chile	CHL	
39	Peru	PER	
40	Indonesia	IDN	
41	Suriname	SUR	
42	Vietnam	VNM	
43	Brunei Darussalam	BRN	
44	Czech Republic	CZE	
45	Mexico	MEX	
46	Poland	POL	
47	Kuwait	KWT	
48	Latvia	LVA	
49	Korea, Rep.	KOR	
50	Kazakhstan	KAZ	
51	Venezuela, RB	VEN	
52	Turkey	TUR	
53	Slovak Republic	SVK	
54	United Arab Emirates	ARE	
55	Bulgaria	BGR	
56	Hungary	HUN	
57	Trinidad and Tobago	TTO	
58	Cuba	CUB	
59	Israel	ISR	
60	Gabon	GAB	
61	Serbia	SRB	
62	Ukraine	UKR	
63	Nepal	NPL	
64	Lithuania	LTU	
65	Myanmar	MMR	
66	Thailand	THA	
67	Belarus	BLR	
68	Philippines	PHL	
69	Georgia	GEO	
70	Bolivia	BOL	
71	Panama	PAN	
72	South Africa	ZAF	

73	Uzbekistan	UZB	
74	Azerbaijan	AZE	
75	Guatemala	GTM	
76	Saudi Arabia	SAU	
77	Sri Lanka	LKA	
78	Cameroon	CMR	
79	Spain	ESP	
80	Montenegro	MNE	
81	Ghana	GHA	
82	El Salvador	SLV	
83	Cyprus	CYP	
84	Iran, Islamic Rep.	IRN	
85	Oman	OMN	
86	Honduras	HND	
87	Malta	MLT	
88	Bangladesh	BGD	
89	Nicaragua	NIC	
90	Algeria	DZA	
91	Egypt	EGY	
92	Armenia	ARM	
93	Macedonia, FYR	MKD	
94	Belize	BLZ	
95	Guyana	GUY	
96	Mongolia	MNG	
97	China	CHN	
98	Tunisia	TUN	
99	Fiji	FJI	
100	Mauritius	MUS	
101	Dominican Republic	DOM	
102	Cambodia	KHM	
103	Turkmenistan	TKM	
104	Jamaica	JAM	
105	Qatar	QAT	
106	Lao PDR	LAO	
107	Nigeria	NGA	
108	Cote d'Ivoire	CIV	
109	Pakistan	PAK	
110	Korea, Dem. People’s Rep.	PRK	
111	Morocco	MAR	
112	Bhutan	BTN	
113	Tajikistan	TJK	
114	Singapore	SGP	
115	India	IND	
116	Senegal	SEN	

117	Maldives	MDV	
118	Kenya	KEN	
119	Lebanon	LBN	
120	Congo, Rep.	COG	
121	Iraq	IRQ	
122	Samoa	WSM	
123	Togo	TGO	
124	Angola	AGO	
125	Barbados	BRB	
126	Mozambique	MOZ	
127	Zambia	ZMB	
128	Sao Tome and Principe	STP	
129	Dominica	DMA	
130	Ethiopia	ETH	
131	Benin	BEN	
132	Jordan	JOR	
133	Libya	LBY	
134	Mali	MLI	
135	Zimbabwe	ZWE	
136	Botswana	BWA	
137	Guinea	GIN	
138	Tanzania	TZA	
139	Hong Kong SAR, China	HKG	
140	Eswatini	SWZ	
141	Congo, Dem. Rep.	COD	
142	Niger	NER	
143	Sudan	SDN	
144	Vanuatu	VUT	
145	Syrian Arab Republic	SYR	
146	Haiti	HTI	
147	Moldova	MDA	
148	Gambia, The	GMB	
149	Cabo Verde	CPV	
150	Sierra Leone	SLE	
151	Lesotho	LSO	
152	Malawi	MWI	
153	Rwanda	RWA	
154	Uganda	UGA	
155	Afghanistan	AFG	
156	Timor-Leste	TLS	
157	Liberia	LBR	
158	Burkina Faso	BFA	
159	Guinea-Bissau	GNB	
160	Solomon Islands	SLB	

161	Comoros	COM																						
162	Yemen, Rep.	YEM																						
163	Namibia	NAM																						
164	Central African Republic	CAF																						
165	Madagascar	MDG																						
166	Mauritania	MRT																						
167	Djibouti	DJI																						
168	Papua New Guinea	PNG																						
169	South Sudan	SSD																						
170	Chad	TCD																						

Legend: Quartiles

	: values between 0 and 25
	: values between 25 and 50
	: values between 50 and 75
	: values between 75 and 100 to 25
	: insufficient data