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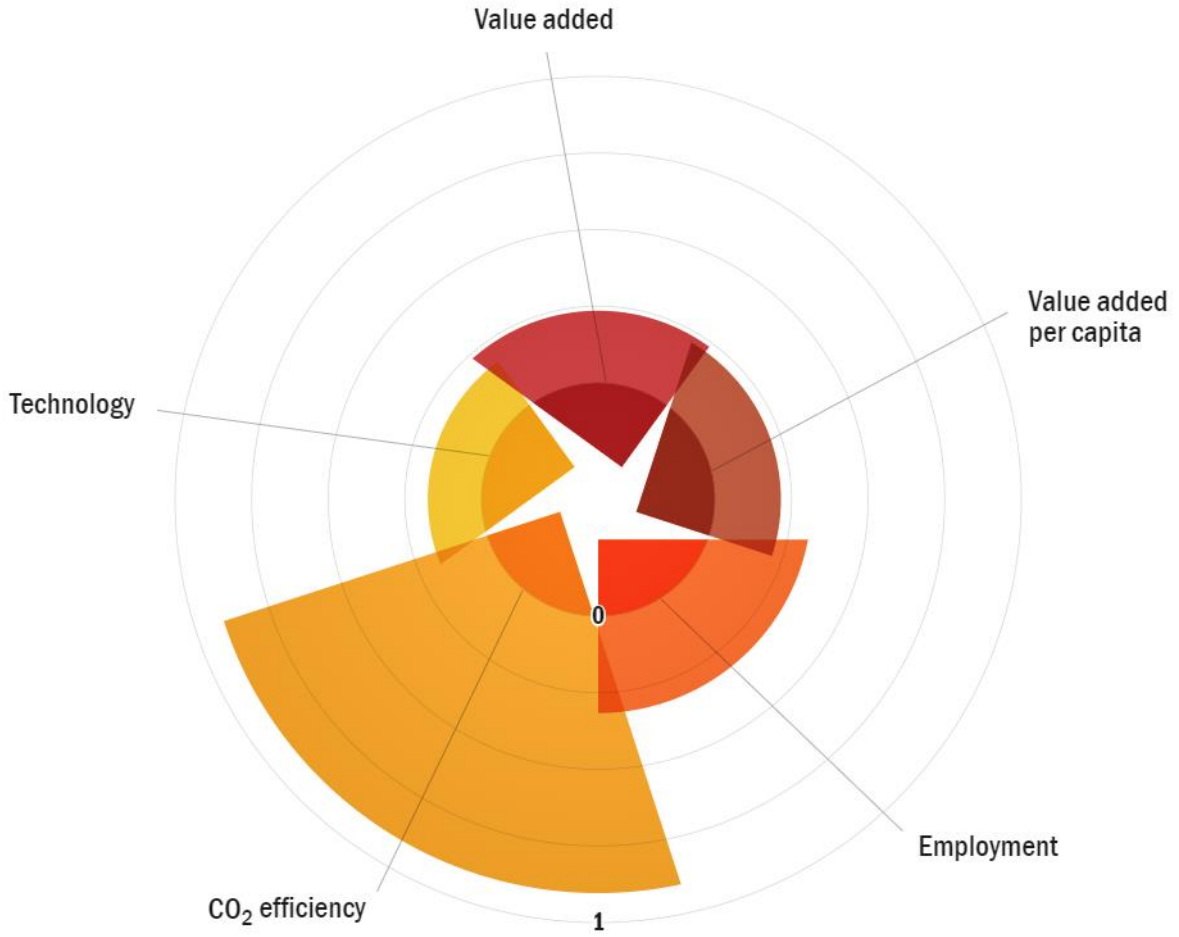
SDG-9 Industry Tracker

– methodological note –

The Industrial Analytics Platform (IAP) provides novel insights into industrial development around the world. It combines reliable statistics and expert analysis with state-of-the-art data visualization tools, making the data-driven content accessible to all.

The SDG-9 Industry Tracker, now provides UNIDO's Member States and their policymakers with timely and in-depth analytical insights on matters related to inclusive and sustainable industrialization.



SDG-9 Industry Index

The SDG-9 Industry Index measures countries' performance towards achieving the industry-related targets of Sustainable Development Goal 9 (SDG-9). The SDG-9 Industry Index represents a comprehensive yet straightforward approach to assess the extent of countries' level of industrialization while promoting social inclusiveness, minimizing natural resource use and environmental impacts. The selection of indicators is based on the global indicator framework for the Sustainable Development Goals developed by the Inter-Agency and Expert Group on SDG Indicators (IAEG-SDGs) and adopted by the United Nations General Assembly (UNGA) on 6 July 2017. The SDG-9 Industry Index's scores indicate the dimensions in which countries lead or lag behind other economies.

Selection of indicators

The objective behind constructing the SDG-9 Industry Index is to measure countries' progress in achieving inclusive and sustainable industrial development (ISID), i.e. the focus is on indicators assigned to the industry-related targets under SDG-9. These targets and indicators are presented in Table 1.

Four targets building on seven indicators are directly linked to the process of industrialization. These indicators refer to all three dimensions of ISID - economic (9.2.1a, 9.2.1b, 9.3.1, 9.3.2, 9.b.1), social (9.2.2) and environmental (9.4.1). Although Target 9.5 calls for enhancing scientific research and upgrading industries' technological capabilities, the indicators assigned to this target by the IAEG-SDGs refer to the economy as a whole. Moreover, data disaggregated by economic activity are not available for conducting a global comparison. As the SDG-9 Industry Index was designed to monitor the industry-related targets, indicators 9.5.1 and 9.5.2 were not considered in the construction process.

The IAEG-SDGs classifies indicators into Tier I, II and III, depending on the availability of an agreed conceptual framework, a precise statistical methodology and the institutional capacity of countries to compile the required data. A Tier I indicator is conceptually clear and is based on an internationally established methodology; standards are available and data are regularly produced by at least 50 per cent of the countries and of the population in every region where the indicator is relevant. A Tier II indicator is also conceptually clear and is based on an internationally established methodology; standards are available, but data are not regularly produced by countries. Tier III refers to indicators for which no internationally established methodology or standards are available yet, but the indicators' methodology/standards are being (or will be) developed or tested. All industry-related indicators are classified as Tier I or Tier II. Those assigned to Target 9.3 reflecting the role of small-scale industrial and other enterprises were reclassified from Tier III to either Tier I or Tier II at the sixth IAEG-SDGs meeting in November 2017. The reporting mechanism is currently being established, starting with initial data collection based on the approved methodological concept. Due to the limited number of countries reporting on Target 9.3, these indicators are at present excluded from the construction of the SDG-9 Industry Index.

The indicators selected for the compilation of the SDG-9 Industry Index are therefore manufacturing value added (MVA) as share of GDP (*MVAsh*, "Value added") and per capita (*MVApc*, "Value added per capita"), manufacturing employment as a share of total employment (*EMP*, "Employment"), CO_2 emissions from manufacturing industries per unit of MVA (*CO2*, "CO_2 efficiency") and the share of medium high- and high-tech manufacturing value added in total value added (*MHT*, "Technology"). Indicators and their data sources are summarized in Table 3. The final dataset is an unbalanced panel data. The complete dataset from 2000 until the most recent available values is used for the construction of the SDG-9 Industry Index.

Targets	Indicators	Custodian agency	Tier
9.1 Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all	9.1.1 Share of the rural population who live within 2 km of an all-season road	World Bank	II
	9.1.2 Passenger and freight volumes, by mode of transport	ICAO, ITF-OECD	I
9.2 Promote inclusive and sustainable industrialization and, by 2030, significantly raise industry's share of employment and gross domestic product, in line with national circumstances, and double its share in least developed countries	9.2.1 Manufacturing value added as a percentage of GDP and per capita	UNIDO	I
	9.2.2 Manufacturing employment as a percentage of total employment	UNIDO	I
9.3 Increase access of small-scale industrial and other enterprises, in particular in developing countries, to financial services, including affordable credit, and their integration into value chains and markets	9.3.1 Percentage share of small-scale industries in total industry value added	UNIDO	II
	9.3.2 Percentage of small-scale industries with a loan or line of credit	UNIDO, World Bank	I
9.4 By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities	9.4.1 CO_2 emissions per unit of value added	UNIDO, IEA	I
9.5 Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular in developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million inhabitants and public and private research and development spending	9.5.1 Research and development expenditure as a percentage of GDP	UNESCO-UIS	I
	9.5.2 Researchers (in full-time equivalent) per million inhabitants	UNESCO-UIS	I
9.a Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support to African countries, least developed countries, landlocked developing countries and small island developing states	9.a.1 Total official international support (official development assistance plus other official flows) to infrastructure	OECD	I
9.b Support domestic technology development, research and innovation in developing countries, including by ensuring a conducive policy environment for, inter alia, industrial diversification and value addition to commodities	9.b.1 Percentage of medium high- and high-tech manufacturing value added in total value added	UNIDO	I
9.c Significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in least developed countries by 2020	9.c.1 Percentage of population covered by a mobile network, by technology	ITU	I

Table 2 SDG-9 targets and indicators

Indicator	Variable name	Label in SDG-9 Industry Tracker	Source
Manufacturing value added as a share of GDP and per capita	*MVAsh* *MVApc*	Value added	UNIDO and UNSD
Manufacturing employment as a share of total employment	*EMP*	Employment	UNIDO and ILO
CO_2 emissions from manufacturing industries per unit of MVA	*CO2*	CO_2 efficiency	UNIDO and IEA CO_2
Share of medium high- and high-tech manufacturing value added in total value added	*MHT*	Technology	UNIDO

Table 3 SDG-9 industry-related indicators and data sources

Methodology

Constructing the final SDG-9 Industry Index requires the normalization of indicators to make them comparable and their subsequent aggregation. The Index follows the methodology proposed in the OECD Handbook on Composite Indicators (OECD, 2008), which provides a systematic approach for the construction and use of such composite measures in practice.

All indicators are first normalized according to the min-max method within the range [0, 1] to standardize the variables for further data aggregation as they have different measurement units. A high value for the indicators *MVAsh*, *MVApc*, *EMP* and *MHT* is considered to be positive, i.e. the country with the highest value is assigned the highest score, namely a value of 1, and the country with the lowest value is assigned the lowest score, a value of 0. As reductions in *CO2* are desirable, we use an inverse normalization for this indicator. The country with the highest level of manufacturing CO_2 intensity is assigned a value of 0, and the country with the lowest CO_2 intensity a value of 1. The min-max method is a useful approach to normalize indicators with a small range of values; however, it can be affected by the presence of extreme values or outliers in the data.

In other words, the SDG-9 Industry Index is constructed by first applying the min-max method, where the minimum and maximum values are taken from each indicator sample:

$$I_{ic}^{t} = \frac{x_{ic}^{t} - min_c x_i^t}{max_c x_i^t - min_c x_i^t} \quad (1)$$

$$I_{ic}^{t} = \frac{max_c x_i^t - x_{ic}^{t}}{max_c x_i^t - min_c x_i^t} \quad (2)$$

where x_{ic}^{t} signifies the value of the i-th indicator for the c-th country at time t. Equation 1 is valid for indicators with higher values representing better performance (*MVAsh*, *MVApc*, *EMP*, *MHT*); equation 2 is valid for indicators with lower values representing better performance (*CO2*).

After all five indicators are normalized, the SDG-9 Industry Index is constructed as a geometric mean using equal weights for each of the k indicators and each country c as:

$$SDG\text{-}9_c^t = \left(\prod_{i=1}^{k} I_{ic}^{t}\right)^{\frac{1}{k}} \quad (3)$$

with values varying within the range [0, 1]. Geometric aggregation allows to limit compensability among indicators. The selection of equal weighting makes the Index highly transparent, a key feature of well-designed indices (OECD, 2008). The logic behind choosing equal weights was also supported by the positive

correlation patterns between normalized indicators that should have a smaller impact on the selection of weights (Foster, 2013).

SDG-9 progress assessment

Assessing progress in SDG-9 can provide valuable information on inclusive and sustainable industrialization across countries. For instance, SDG Target 9.2 aims to "significantly raise industry's share of employment and gross domestic product, in line with national circumstances, and double its share in least developed countries" (UNIDO 2019, p. 9). We examine the progress made in SDG-9 industry-related targets and introduce additional indices for a more comprehensive assessment across countries and SDG-9 indicators. These indices track countries' current performance (Current Status Index) as well as the likelihood of achieving their targets by 2030 (Achievement Likelihood Indicator); they are based on those developed by UNESCAP, for example, in Bidarbakhtnia (2020).

Setting targets

How progress in each of the multiple dimensions of inclusive and sustainable industrialization is understood depends on country-specific circumstances. For example, while some countries only have limited industrial output, others have high levels of manufacturing production but in emissions-intensive industries. Absolute and global targets on industrial development therefore make little sense. To best capture relevant country-specific progress in individual SDG-9 indicators, we instead set relative targets based on countries' starting points in different indicators.

Our central measure of relative progress in SDG-9 indicators is the average annual growth rate of the three fastest-growing economies in a benchmark group after controlling for outliers. The benchmark groups are based on SDG geographic regions.[1]

SDG-9 does not provide any specific target values to be achieved by 2030 except of SDG Target 9.2. SDG Target 9.2 provides an additional possibility to measure relative progress in industry-related targets: to double the 2015 indicator values by 2030. Such targets are, however, unlikely to be relevant for countries beside LDCs and indicators beside *EMPL* and *MVAsh*. Table 4 presents an overview of the methodology and parameters to set relative targets discussed in the rest of this note.

Method	Benchmark group	Target setting
Current Status Index	Comparator countries from the same: - SDG geographic region	Average growth rate of the top 3 economies
Achievement Likelihood Indicator	Country itself: - Indicator value in 2015	Doubling of base value (only relevant for LDCs)

Table 4 Overview of SDG-9 progress assessment methodology

[1] https://unstats.un.org/sdgs/indicators/regional-groups/

Data and outliers

Countries' growth rates in each indicator are the key measures of progress in achieving their relative targets. There is considerable variation both between countries in each indicator and across indicators. For example, while compound annual growth rates in *MVAsh* are fairly concentrated around the median, those of *CO2* are far more dispersed.

Some countries exhibit exceptionally high or low growth rates. This may be caused by specific circumstances or measurement errors and may therefore not be reproducible elsewhere. To avoid distortion caused by these values and to calculate more realistic targets, outliers are identified and removed using z-scores.

Here, we set a z-score of 2—which means two standard deviations from the mean—as the threshold above which values are considered as outliers. This method leads to variable maximum and minimum growth rates across indicators depending on the distribution of the data. For example, the tolerance for high or low growth rates is higher for the indicator *CO2*, as the standard deviation is larger than for the other indicators.

Progress (Current Status Index)

The Current Status Index (CSI) measures countries' progress in SDG-9 indicators between 2000 and 2017, with the level of progress in an indicator being measured as the normalized distance to a target value (Bidarbakhtnia, 2020).[2] This allows for comparisons across indicators, countries and reference groups. The CSI is calculated as:

$$CSI_{17} = \frac{I_{17} - I_{00}}{|TV - I_{00}|} \times D$$

with I_{17} and I_{00} representing the indicator values for a specific country in 2017 and 2000, respectively. D denotes whether an increase or decrease in the indicator is desirable or not:

$$D = \begin{cases} 1 & \text{increase desirable for MVApc, MVAsh, EMPL, MHT} \\ -1 & \text{decrease desirable for CO2} \end{cases}$$

The target value *TV* measures the progress a country could achieve in each indicator by 2030 if it grew at the rate of the top three countries in the benchmark group. It is calculated for each country as:

$$TV = (1 + g_{BG})^{13} \times I_{17}$$

with g_{BG} signifying the average annual growth rate of the benchmark group after controlling for outliers.

In some cases, all countries within the benchmark group exhibit negative growth rates and hence $g_{BG} < 0$, although the desired growth rate is positive. Setting targets with these values implies that a negative target should be pursued. To avoid such cases, the target value is therefore set to maintain the existing levels, i.e. $g_{BG} = 0$.

To assess progress on SDG Target 9.2 in LDCs, the TV equation becomes $TV = 2 \times I_{15}$. For each indicator, there is a bandwidth within which a target value is considered applicable. The limits are set as the maximum and minimum observed global values in the most recent year (2017) once outliers have been eliminated using a z-score of 3.

The resulting CSI falls within the range [-1, 1], with positive values implying progress towards the target. Corresponding progress assessment categories used for the SDG-9 Industry Tracker are summarized in Table 5.

Current Status Index	Progress	Text	Symbol

[2] For an overview of normalization methods, refer to OECD (2008).

[-1; 0]	Negative	The country's performance has deteriorated or stagnated since 2000	**Negative**
(0; 0.2]	Insignificant	The country has made only insignificant progress since 2000	 **Insignificant**
(0.2; 0.56]	Fair	The country has made respectable progress since 2000	 **Fair**
(0.56; 1]	Substantial	The country has made substantial progress since 2000	 **Substantial**

Table 5 Categories of progress based on the Current Status Index

Outlook (Achievement Likelihood Indicator)

Achievement Likelihood (AL) Indicator complements the CSI by estimating countries' likelihood of meeting their respective indicator targets given the current trend. It is calculated as:

$$AL = 1 - \frac{|TV - I_{30}|}{|TV - I_{17}|}$$

AL thereby reflects both the countries' expected relative progress between 2017 and 2030, and the absolute distance to the target in both years.[3] The indicator value in 2030, I_{30}, is estimated using a weighted linear regression. This attaches greater importance to more recent years and is calculated as:

$$I_j = \beta_0 + \beta_1(I_j t_j), \quad (j = 1,2, \dots, n),$$

with the slope coefficient β_1 as the weighted growth rate used to estimate future indicator values. Weights are assigned as:

$$w_j = \frac{t_j}{t_n}, \quad (j = 1,2, \dots, n),$$

with t_n signifying the most recent year of data for each indicator. This means that recent trends in the data have greater influence on the forecasted value for 2030.

The resulting value lies in the interval [0, 1], with a greater AL as I_{30} approaches *TV* or with greater progress achieved in the indicator until 2030, i.e. a larger gap between I_{30} and I_{17}. While a country-specific analysis is required for policy recommendations, lower values of the AL generally indicate a stronger need for action if the SDG is to be met. Corresponding outlook assessment categories used for the SDG-9 Industry Tracker are summarized in Table 6.

By assigning more weight to recent values to calculate the AL, its results can diverge from those of the CSI if there has been a recent change in the underlying trend of the time series. Taken together, the indices can provide insights into what the data tell us about both current and expected inclusive and sustainable industrialization trajectories.

Achievement Likelihood	Outlook	Text	Symbol
0	Reverse trend	To reach the target in 2030, the country has to reverse its negative trend	 **Reverse trend**
(0; 0.8]	Accelerate progress	To reach the target in 2030, the country will need to accelerate progress	 **Accelerate progress**
(0.8; 1]	On track	If the economy continues to progress at current speed, it is likely to reach the target in 2030	 **On track**

Table 6 Categories of Outlook based on the Achievement Likelihood

[3] If TV = I_{17} (when g_{BG} is set to 0, as discussed above), this equation cannot be solved. The AL is then set to 0 as the observed growth must have developed in the undesired direction for this to occur.

References

Bidarbakhtnia, A. (2020). Measuring Sustainable Development Goals (SDGs): An Inclusive Approach. *Global Policy*, 11(1), 56-67.
Foster J. E., McGillivray M., and Seth S. (2013). Composite Indices: Rank Robustness, Statistical Association, and Redundancy. *Econometric Reviews*, 32(1), 35-56.
OECD (2008). Handbook on Constructing Composite Indicators – Methodology and User Guide. OECD Publishing. Paris.
OECD (2019). Measuring Distance to the SDG Targets 2019: An Assessment of Where OECD Countries Stand. OECD Publishing, Paris.
UNIDO (2019). Statistical Indicators of Inclusive and Sustainable Industrialization: Biennial Progress Report 2019. UNIDO, Vienna.

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