Goal: 7. Ensure access to affordable, reliable, sustainable and modern energy for all.

Target: 7.b. By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing states and landlocked developing countries, in accordance with their respective programmes of support.

Indicator: 7.b.1: Installed renewable energy-generating capacity in developing countries (in watts per capita)

Institutional information

Organization(s):

International Renewable Energy Agency (IRENA)

Concepts and definitions

Definition:

The indicator is defined as the installed capacity of power plants that generate electricity from renewable energy sources divided by the total population of a country. Capacity is defined as the net maximum electrical capacity installed at the year-end and renewable energy sources are as defined in the IRENA Statute (see concepts below).

Concepts:

Electricity capacity is defined in the International Recommendations for Energy Statistics or IRES (UN, 2018) as the maximum active power that can be supplied continuously (i.e., throughout a prolonged period in a day with the whole plant running) at the point of outlet (i.e., after taking the power supplies for the station auxiliaries and allowing for the losses in those transformers considered integral to the station). This assumes no restriction of interconnection to the network. It does not include overload capacity that can only be sustained for a short period of time (e.g., internal combustion engines momentarily running above their rated capacity).

The IRENA Statute defines renewable energy to include energy from the following sources: hydropower; marine energy (ocean, tidal and wave energy); wind energy; solar energy (photovoltaic and thermal energy); bioenergy; and geothermal energy.

Rationale:

The infrastructure and technologies required to supply modern and sustainable energy services cover a wide range of equipment and devices that are used across numerous economic sectors. There is no readily available mechanism to collect, aggregate and measure the contribution of this disparate group of products to the delivery of modern and sustainable energy services. However, one major part of the energy supply chain that can be readily measured is the infrastructure used to produce electricity.

Renewables are considered a sustainable form of energy supply, as their current use does not usually deplete their availability to be used in the future. The focus of this indicator on electricity reflects the emphasis in the target on modern sources of energy and is particularly relevant for developing countries where the demand for electricity is often high and its availability is constrained. Furthermore, the focus on renewables reflects the fact that the technologies used to produce renewable electricity are generally modern and more sustainable than non-renewables, particularly in the fastest growing sub-sectors of electricity generation from wind and solar energy.

The division of renewable electricity capacity by population (to produce a measure of Watts per capita) is proposed to scale the capacity data to account for the large variation in needs between countries. It uses population rather than GDP to scale the data, because this is the most basic indicator of the demand for modern and sustainable energy services in a country.

This indicator should also complement indicators 7.1.1 and 7.2. With respect to electricity access, it will provide additional information to the proportion of people with electricity access by showing how much infrastructure is available to deliver that access (in terms of the amount of capacity per person). The focus on renewable capacity will also add-value to the existing renewables indicator (7.2) by showing how much renewable energy is contributing to the need for improved electricity access.

Comments and limitations:

At present, electricity only accounts for about one-quarter of total energy use in the World and an even lower share of energy use in most developing countries. The focus of this indicator on electricity capacity does not capture any trends in the modernisation of technologies used to produce heat or provide energy for transport.

However, with the growing trend towards electrification of energy end-uses, the focus here on electricity may become less of a weakness in the future and may also serve as a general indicator of the progress towards greater electrification in developing counties. That, in itself, should be seen as a shift towards the use of more modern technology to deliver sustainable energy services.

Furthermore, as reflected in many national policies, plans and targets, increasing the production of electricity and, in particular, renewable electricity, is seen by many countries as a first priority in their transition to the delivery of more modern and sustainable energy services. Thus, this indicator is a useful first-step towards measuring overall progress on this target that reflects country priorities and can be used until other additional or better indicators can be developed.

Methodology

Computation method:

For each country and year, the renewable electricity generating capacity at the end of the year is divided by the total population of the country in that year.

Treatment of missing values:

- **At country level:**

At the country level, electricity capacity data is sometimes missing for two reasons:

1. Delays in responding to IRENA questionnaires or publication of official data. In such cases, estimates are made so that global and regional totals can be calculated. The most basic treatment is to

repeat the value of capacity from the previous year. However, IRENA also checks unofficial data sources and collects data about investment projects (see Indicator 7.a.1). These other sources can be used to identify if any new power plants have been commissioned in a year and are used where available to update the capacity value at the end of a year. Any such estimates are eventually replaced by official or questionnaire data when that becomes available.

2. Off-grid capacity data is frequently missing from national energy statistics, or is presented in non-standard units (e.g. numbers of mini-hydro plants in a country rather than their capacity in MW). Where official data is not available, off-grid capacity figures are collected by IRENA from a wide variety of other official and unofficial sources in countries (e.g. development agencies, government departments, NGOs, project developers and industry associations) and this information is added to the capacity database to give a more complete picture of developments in the renewable energy sector in a country. This data is peer reviewed each year through an extensive network of national correspondents (the REN21 Network) and is checked with IRENA country focal points when they attend IRENA meetings and training workshops.

- **At regional and global levels:**

See above. Regional and global totals are only estimated to the extent that figures for some countries may be estimated in each year. (See also data availability below).

Regional aggregates:

Regional and global totals are calculated by summing the renewable generating capacity for a region or the World and dividing that by the corresponding figure for total population.

Sources of discrepancies:

The main source of discrepancies between different sources of electricity capacity data are likely to be due to the under-reporting or non-reporting of off-grid capacity data (see above) or slight variations in the definition of installed capacity. IRENA uses the IRES definition of capacity agreed by the Oslo Group on Energy Statistics, while some countries and institutions may use slightly different definitions of capacity to reflect local circumstances (e.g. the reporting of derated rather than maximum net installed capacity or the reporting of built rather than commissioned capacity at year-end).

Methods and guidance available to countries for the compilation of the data at the national level:

Guidance for the collection of electricity capacity data is provided by the International Recommendations for Energy Statistics. IRENA also produces methodological guidance for countries, specifically about how to measure renewable energy and collect renewable energy data. This is supported by a comprehensive programme of regional renewable energy statistics training workshops and ongoing communications with countries as part of the annual questionnaire cycle.

Consultation/validation process with countries for adjustments and estimates:

All countries are invited to provide their capacity data or at least review the data that IRENA has compiled (from other official and unofficial sources) through an annual process of data collection using the IRENA Renewable Energy Questionnaire. This process is reinforced through IRENA’s renewable energy statistics training workshops, which are held twice a year in different (rotating)

regions. To date, over 200 energy statisticians have participated in these workshops, many of whom provide renewable energy data to IRENA. In addition, IRENA's statistics are presented each year to member countries at one of IRENA's three governing body meetings, where discrepancies or other data issues can be discussed with country representatives.

Quality assurance:

IRENA data are compiled from national sources following the United Nations Fundamental Principles of Official Statistics: https://unstats.un.org/unsd/dnss/gp/fundprinciples.aspx.

Data sources

Description:

IRENA's electricity capacity database contains information about the electricity generating capacity installed at the year-end, measured in MW. The dataset covers all countries and areas from the year 2000 onwards. The dataset also records whether the capacity is on-grid or off-grid and is split into 36 different renewable energy types that can be aggregated into the six main sources of renewable energy.

Collection process:

The capacity data is collected as part of IRENA's annual questionnaire cycle. Questionnaires are sent to countries at the start of a year asking for renewable energy data for two years previously (i.e. at the start of 2019, questionnaires ask for data for the year 2017). The data is then validated and checked with countries and published in the IRENA Renewable Energy Statistics Yearbook at the end of June. To minimise reporting burden, the questionnaires for some countries are pre-filled with data collected by other agencies (e.g. Eurostat) and are sent to countries for them to complete any additional details requested by IRENA.

At the same time as this, preliminary estimates of capacity for the previous year are also collected from official sources where available (e.g. national statistics, data from electricity grid operators) and from other unofficial sources (mostly industry associations for the different renewable energy sectors). These are published at the end of March.

Population data:

For the population part of this indicator, IRENA uses a 6-source consolidation by the World Bank, which is available through the World Bank's World Development Indicators database. The indicator reflects the residents in a country or area regardless of legal status or citizenship. The values are midyear estimates.

The World Bank publishes more information about this indicator in their metadata:

https://databank.worldbank.org/reports.aspx?source=2&type=metadata&series=SP.POP.TOTL

Data availability

Description:

The total number of capacity records in the database (all developing countries/areas, all years since 2000, all technologies) is 11,000. In terms of numbers of records, 3,120 (28%) are estimates and 740 (7%) are from unofficial sources. The remaining records (65%) are all from returned questionnaires or official data sources.

However, in terms of the amount of capacity covered in the database, the shares of data from estimated and unofficial sources is only 5% and 1% respectively. The large difference between these measures is due to the inclusion of off-grid capacity figures in the database. The amount of off-grid generating capacity in a country is quite frequently estimated by IRENA, but the amounts of off-grid capacity recorded in each case is often relatively small.

Time series:

Renewable generating capacity data is available from 2000 onwards.

Disaggregation:

IRENA's renewable capacity data is available for every country and area in the world from the year 2000 onwards. These figures can also be disaggregated by technology (solar, hydro, wind, etc.) and by on-grid and off-grid capacity.

Calendar

Data collection:

Capacity data is recorded as a year-end figure. The data is collected in the first six months of every year

Data release:

Estimates of generating capacity for a year are published at the end of March in the following year. Final figures for the year before that are published at the end of June.

Data providers

Renewable energy generating capacity:

National Statistical Offices and National Energy Agencies of Ministries (the authority to collect this data varies between countries). Data for preliminary estimates may also be collected from industry associations, national utility companies or grid operators.

Population:

The World Bank consolidates and publishes population data coming from the following data providers:

1. United Nations Population Division. World Population Prospects.
2. Census reports and other statistical publications from national statistical offices

3. Eurostat: Demographic Statistics
4. United Nations Statistical Division. Population and Vital Statistics Report
5. U.S. Census Bureau: International Database
6. Secretariat of the Pacific Community: Statistics and Demography Programme.

Data compilers

International Renewable Energy Agency (IRENA).

References

IRENA Statistical Yearbooks: https://www.irena.org/Statistics.

Related indicators

Not applicable.