



ACCELERATING SDG 7 ACHIEVEMENT

POLICY BRIEF 27

INDICATORS AND DATA ON ENERGY
FOR SUSTAINABLE DEVELOPMENT

7 AFFORDABLE AND
CLEAN ENERGY



POLICY BRIEF #27

INDICATORS AND DATA ON ENERGY FOR SUSTAINABLE DEVELOPMENT

Developed by

United Nations Economic Commission for Europe (UNECE)

In collaboration with

IEA, World Bank, WHO, UNECA, UNECLAC, UNESCAP, UNESCWA

KEY MESSAGES

Status of indicators and data and progress towards achievement of SDG 7

- Tracking of progress towards achieving SDG 7 shows that i) current approaches on indicators could be refined, and ii) capacities to collect relevant data need enhancement. Adopting international methodologies for statistics and indicators is a prerequisite for improved analytical quality, global coverage, and comparability.
- Current indicators are derived from the existing data gathering and reporting infrastructure. In order to enhance policies that accelerate the energy transition, it will be necessary to adapt the existing indicators for energy access, energy efficiency, and renewable energy. It will also be necessary to develop new indicators for the future system and to develop capacities to collect, analyse, track and report the new data and indicators. New indicators should embrace nexus areas of water, food, and climate, track investments in clean energy, and address other forms of energy.
- Decision makers would be better informed with a broader range of forward-looking indicators that cut across the 2030 Agenda. Considering a broader concept of “energy for sustainable development” would measure progress towards all energy-related SDGs to reflect cross-cutting interconnections among the SDGs.

Priority Actions

- On energy access, the SDG 7 indicators relate to how many people have access to electricity and to clean cooking fuels and technologies. Complementary indicators could address challenges of affordability, reliability, quality of access, access to heating services, and access to other kinds of energy.
- Energy efficiency is commonly measured by energy intensity (the energy needed to produce one unit of economic output). Other useful indicators could be energy productivity (the ratio of GDP to total primary energy supply (TPES)), and the efficiency with which primary energy resources are transformed into useable energy at the point of consumption.
- For renewable energy, the SDG 7 indicator is the share of renewable energy in TFC. Further indicators of progress would be: the share of renewable energy in TPES, renewable energy generating capacity, and investments in renewable energy. Indicators related to renewable energy should distinguish between traditional biomass and modern renewable energy, as these have very different social, economic and environmental implications.
- Reinforce and adequately resource energy statistics programmes that monitor and report comprehensive energy data, and integrate fully with other economic and social national statistical efforts.
- Ensure that full energy balances are produced regularly and in a timely fashion by governments, and international methodologies are adopted to ensure data comparability.
- Develop appropriate indicators for the system of the future, adapt existing data gathering systems, and build required capacities to collect and analyse data—then track and report on both data and indicators.
- Develop new indicators that embrace nexus areas on water, food, climate, investments in clean energy, and other forms of energy.
- Strengthen analytical capacity concerning interactions involving energy and climate, especially the water-food-energy nexus, in order to support innovative sustainable policy approaches to address these multidisciplinary, energy-related issues.
- Develop specialized national energy data observatories to centralize the consolidation, processing and analysis of energy-related data and indicators.

Adapting and Complementing the SDG 7 Indicators

Energy Access

Energy is essential for sustainable development and poverty eradication. In 2015 about 2.8 billion people had no access to modern energy services and over 1.1 billion did not have electricity (World Bank and IEA 2018). The SDG 7 indicators for energy access are the shares of population with physical access to electricity and the shares of population with access to clean cooking fuels and technology. However, even in countries with 100 per cent or near 100 per cent physical access to electricity, many people are challenged by issues of affordability, quality of access, and quality of service. Additional indicators that would address these challenges include affordability and reliability of electricity access (UNECE 2017).

For both electrification and cooking, the World Bank has developed a Multi-Tier Framework methodology that is a measure of energy access covering seven quality dimensions (including affordability and reliability) and places households in one of five tiers of access (as opposed to the traditional binary measure). The methodology, based on surveys, picks up deficiencies in service that are relevant even outside of the high access deficit countries. A first Global Energy Access Survey is under way in 15 high access deficit countries. The survey and analysis will apply this approach systematically on a large scale (World Bank 2017).

In cold climates, affordability and service quality of heating services (not electricity) are particular challenges with the lock-in of older, fossil fuel based heat infrastructure and poor insulation. Complementary indicators to show progress in this area would be heat demand, affordability of heating, and quality of heating services.

Energy Efficiency

A commonly used measure for energy efficiency is energy intensity, although the two are not equivalent. Energy intensity, in itself, does not reflect differing economic structures, availability of resources, activity levels or climatic drivers for energy use. It is an indication of how much energy is needed to produce one unit of economic output: a lower ratio indicates that less energy is used to produce one unit of output. The SDG 7 indicator is the rate of growth in energy intensity measured as the ratio of TPES to GDP, with the latter measured in a way designed to avoid distortions caused by exchange rate fluctuations.

An alternative to energy intensity is its mathematical inverse, energy productivity. Energy productivity has the positive connotation of improving productivity, whereas energy intensity has the negative connotation of having to stop using so much energy. Most

governments are more motivated to improve their country's social wellbeing, economic productivity and environmental impacts than to "save energy". Intuitively, people adopt concepts more willingly when improvement leads to an increase in value rather than a decrease. The recommended complementary indicator is therefore energy productivity (absolute, not the rate of growth) measured as the ratio of GDP to total primary energy supply.

Several national and international initiatives are developing end use indicators to track progress on energy efficiency across sectors. (There is currently inadequate data to calculate energy productivity at the sub-sector level.) End use indicators may be more or less disaggregated depending on the data availability, and require both energy and "activity" data from outside the energy statistics domain that make the data collection challenge greater. While methodologies have been developed internationally, outside of the OECD and a handful of larger countries, there is little good data on energy outputs, particularly in the transportation sector (vehicle-kilometres travelled) or building sector (square metres of area). Without the ability to drill down into the sectoral and sub-sectoral level, the diagnosis of energy efficiency challenges remains quite rough. Solving this issue will require the adoption of common methodologies and a concerted cross-sectoral data gathering effort, as often the missing information will have to come from the energy-using sector rather than from the energy sector itself.

Other indicators for energy efficiency relate to the production, transmission, and distribution of electricity, and the efficiency with which primary energy resources are transformed into useable energy at the point of consumption. Efficiency in electricity generation, measured as primary energy used for electricity production divided by delivered electricity, would provide a useful measure of supply side efficiency. The Global Tracking Framework reports on supply side efficiency, with thermal generation efficiency, and transmission and distribution losses, (using IEA data) as complementary indicators (World Bank and IEA 2017, 2018).

Renewable Energy

The SDG 7 indicator for renewable energy is the share of renewable energy in total final consumption (TFC). Measuring renewable energy as a share of energy is an indicator of progress in: reducing global greenhouse gas (GHG) emissions and local pollution sources; a country's progress in developing and utilizing available resources sustainably; and improving sustainability over the entire energy value chain. Measurement of renewable energy as a share of TFC can be useful, but it ignores the 6-8 per cent transmission losses that are incurred through the transmission and distribution network. A second option is an indicator expressing renewable energy as a share of TPES, but this measurement ignores losses incurred in the combustion of fossil fuels. While both indicators have their advantages, it is important to understand primary

energy options and their implications. Both indicators can be used, but they must be interpreted carefully. A third option would be an indicator that could account for exergy, or entropy. In this case, renewable energy's contribution is evaluated with respect to total primary energy requirements (TPER), based on the primary energy required to provide its equivalent input to the energy system. This indicator would reflect the real contribution of renewable energy to reducing GHG emissions and displacing non-renewable energy sources.

Further indicators of progress on renewable energy would be renewable energy generating capacity additions, and investments in renewable energy capacity. Tracking investments in renewable energy capacity provides further insight into the success of developing renewable energy.

All of the indicators related to renewable energy should distinguish between use of traditional biomass and modern renewable energy.

SDG targets 7A and 7B

SDG 7 targets 7A and B need to be monitored closely with appropriate indicators to track mobilization of funding, investment in energy efficiency, and foreign direct investment in infrastructure and technology.

Recommendations for Energy Indicators in addition to SDG 7

In order to inform policies to accelerate the transition to an energy system that can support sustainable development, it will be necessary to: develop appropriate indicators adapted to the system of the future; adapt existing data gathering systems; and build the required capacities to collect, analyse, track and report new data and indicators. The total set of indicators should be comprehensive but focused so that clear and accurate messages emerge for decision makers.

At a minimum, new indicators should: embrace the nexus areas with water, food, and climate; track investments in clean energy; and enlarge the chosen energy indicators to include other forms of energy. The 2018 global tracking report includes a special chapter addressing nexus issues (World Bank and IEA 2018). For energy, it is critical to think in terms of a wholly interconnected, complex system, in which supply, demand, conversion, and transport/transmission interact freely and flexibly to deliver affordable energy services to customers. This perspective applies within regions and sub-regions, and also between regions and economic sectors.

Indicators to track energy for sustainable development in addition to those for SDG 7 show that increased efforts are required throughout the energy system. Attaining the objectives of the 2030 Agenda will require full engagement of the private sector to transform energy. As a consequence, it is essential to monitor

progress on energy for sustainable development in ways that reflect the cross-cutting interconnections among the SDGs and that involve the private sector in more integrated ways.

Given that world's share of fossil fuels in TPES is 80 per cent and will likely remain above 50 per cent in the coming decades, the transition to a clean, affordable and low-carbon energy system will require solutions for the use of fossil fuels. To track progress towards this objective, the share of fossil fuels in the energy system could be one additional indicator to measure progress towards a low-carbon future. Other indicators could include the efficiency of fossil fuel based power generation and methane (CH₄) emissions along the energy value chain. To assess whether targets linked to SDG 13 on climate can be achieved, it would be useful to provide information on the GHG and/or CO₂ intensity of TPES and TFC, and carbon dioxide (CO₂) emissions from fossil combustion. This information is available from the IEA (UNECE 2017)

The data gathering and reporting infrastructure that exists today has emerged and evolved over many years, and changes and improvements to this system require extensive consultation, adaptation, and capacity development support. This process is ongoing, but will take more time to realize in practice. Tracking important pillars, such as the carbon intensity of energy or per capita carbon emissions, is difficult because of missing data or differences in reporting approaches.

A number of new paradigms have emerged from recent analyses regarding indicators for the future, whether related to quality of service or holistic systems analysis. There is merit in considering what indicators would point to a future in which energy for sustainable development is assured. Once a concise set of indicators has been identified, it will be necessary to establish new data gathering infrastructure. The tables annexed to this policy brief set forth a broad range of possible indicators of energy for sustainable development.

Transforming energy from a commodity business to a service business

The energy industry has succeeded in raising the quality of life around the world through the provision of energy services, most notably in the advanced economies, but access and affordability challenges remain. It was noted above that affordability should be included in the measure of energy access. That perspective considers kWh units sold and bought as a share of household budgets. New approaches from a services perspective will allow those without access to energy to leapfrog over existing technology and systems and benefit from innovation and falling technology costs. Current indicators will not capture that shift.

Changing the energy industry to a service configuration involves changing the business model of a utility (or service provider) to

one that maximizes the margins between the revenues received for services provided (for example, indoor comfort or mobility) and the costs of providing those services (through, for example, efficiency investments). Realising the potential for this will require careful reconsideration of, and readiness to revisit, the existing regulatory, policy, technical, and organizational infrastructure of energy systems. These are the types of considerations that a more complete set of indicators would be able to inform. There should be an engaged and continuing conversation about what changes are required, the relevant indicators that would point to progress, and the data (and sources) that would be needed to populate the indicators.

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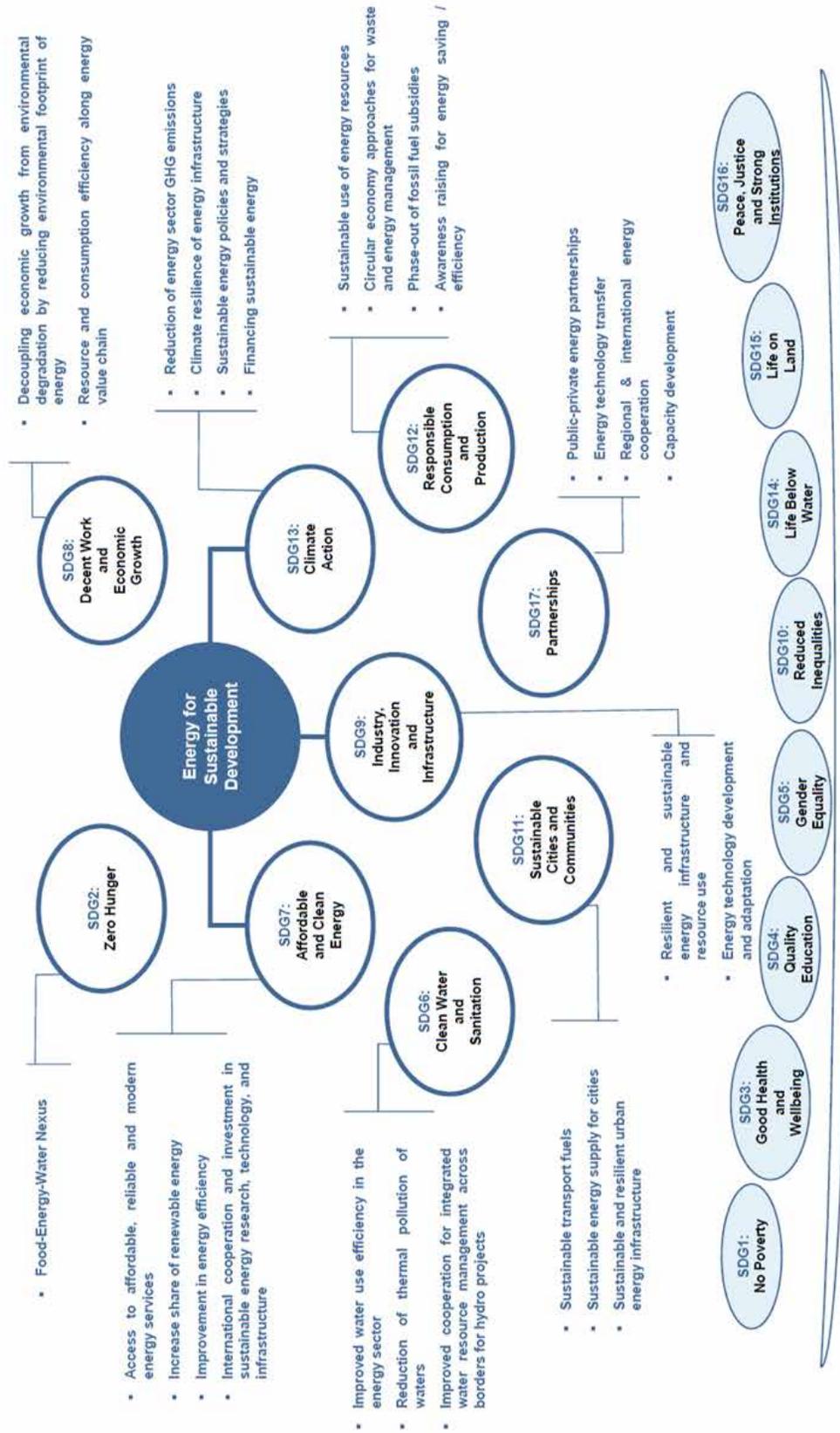
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Figure 27.1
Contribution of Energy to the 2030 Agenda for Sustainable Development



Source: UNECE (2017). *Global Tracking Framework: UNECE Progress in Sustainable Energy*.

Possible Indicators Considered for Energy for Sustainable Development

(Bold Red: SDG 7 current indicators; Bold Blue: Recommended complementary indicators; Black: indicators considered but not recommended)

Pillars	Suggested Indicators (or areas for indicator formulation)
ENERGY	
Energy Access	<ul style="list-style-type: none"> • 7.1.1 Proportion of Population with Primary Reliance on Clean Cooking Fuels and Technology • 7.1.2 Proportion of Population with Access to Electricity • Affordability, expressed as share of household income spent on energy <p>Suggested areas to formulate additional indicators:</p> <ul style="list-style-type: none"> • Reliability and quality of electricity access <ul style="list-style-type: none"> – Number of hours of access to electricity per day (outage rates) – Technical quality (frequency, voltage) – Number of turnoffs by type of consumer – Number of households with access to main grid – Time required to fix disruptions – Number of households with generators – Loss of GDP through interrupted supply (VOLL) – Transmission losses • Energy Poverty, encompassing access to and quality of heating and cooling
Renewable Energy	<ul style="list-style-type: none"> • 7.2.1 Renewable Energy Share in Total Final Energy Consumption (TFC) • Share of modern / traditional renewable energy in TFC • Share of renewable energy in Total Primary Energy Supply (TPES) • Additions of renewable energy installed capacity (installed and rated) • Investments in renewable energy • Share of renewable energy in bus-bar energy (e.g., post combustion but pre transmission and distribution losses) • Installed reliable renewable energy capacity per capita • Renewable energy by type of output (electricity, liquids, heat) • Ratio of renewable energy (capacity, production/consumption) to total electricity (capacity, production/consumption) • Share of renewable energy expressed in terms of Total Primary Energy Requirements (TPER, <i>i.e.</i>, taking into account the actual non-renewable primary energy required to provide the same final RE). • Number of people with access to RE • Terms of access of renewable producers to networks • Share of renewable energy in installed reliable capacity (versus generation) • Cost of producing 1kWh from solar PV / Wind /other renewable energy (under consideration of distribution losses with a view towards improving the network) • Installed energy storage (batteries (including EV's), pumped storage, phase change materials, other technologies)

Pillars	Suggested Indicators (or areas for indicator formulation)
Energy Efficiency	<ul style="list-style-type: none"> • 7.3.1 Energy Intensity Measured in Terms of TPES to GDP (MJ/USD) • Energy Productivity Measured in Terms of GDP to TPES (USD/MJ) • Supply side efficiency in electricity generation • Ratio of TFEC to GDP (MJ/USD) • Compound annual growth rate, or CAGR of TFC as well as of TPES • Transmission losses • Ratio of TPES to TFC net of imports and exports • For SDG indicator 7.a.1: Replace “USD invested in energy efficiency” with “USD invested divided by energy saved over the life of the investment” • Price elasticities of energy demand and supply • Spend by governments on energy efficiency (through grants, concessionary finance etc.). <p>Sector-specific Indicators (industry, transport, buildings) required disaggregated data</p> <ul style="list-style-type: none"> • Energy use in buildings (kWh per m² of used space) • Efficiency measured as the amount of energy needed to provide demanded energy services <p>Sector-specific Physical Energy Intensity Indicators</p> <ul style="list-style-type: none"> • Specific energy consumption defined as the amount of energy to produce a tonne of steel
Other Energy Sources	<ul style="list-style-type: none"> • Share of fossil fuel in TPES • Efficiency of fossil fuels in generation • Methane emissions along the value chain • Share of nuclear in TPES • Cost comparison of unsubsidized renewable energy with unsubsidized fossil • Bringing it all together, Fuel Mix in TPES; Fuel mix in Electric Generating Capacity; TFC by end-use
NEXUS	
Climate	<ul style="list-style-type: none"> • CO2 emissions from fossil fuel combustion (total and per capita) per TPES and per TFC • GHG emissions of energy sector
Water	<ul style="list-style-type: none"> • Clean water treatment (sanitation, desalination volumes and efficiency, ...) • Water resource depletion (aquifer), intermittent energy supply • Fracking and water use, chemical pollutions • Water cooling systems in the energy world (evaporation losses, thermal losses through cooling) • Transfer of water (system to system, transboundary), hydro, agriculture • Impacts of large hydro development • International water resource management • Thermal pollution in rivers / impact of water cooling systems in energy generation

Pillars	Suggested Indicators (or areas for indicator formulation)
Land	<ul style="list-style-type: none"> • Land intensity of renewable energy (wind, solar, biomass) • Deforestation caused by use of traditional biomass <p>Suggested areas to formulate additional indicators:</p> <ul style="list-style-type: none"> – Land management in cities – International land management
Food	<ul style="list-style-type: none"> • Food waste for biofuels / compost • Fertiliser production • Energy embodied in food exports / imports
Environment	<ul style="list-style-type: none"> • Energy use per passenger miles <p>Suggested areas to formulate additional indicators:</p> <ul style="list-style-type: none"> – Air quality / health / exposure; Health impacts of household air pollution – Waste as resource: Recycling; waste to energy
Socioeconomic	<ul style="list-style-type: none"> • Energy poverty / affordability: household money spent on energy <p>Suggested areas to formulate additional indicators:</p> <ul style="list-style-type: none"> – Quality of building codes (does it cover humidity, indoor air quality) – Embodied energy in materials and structures (cement, steel, use) – Economic value added of energy exports (benefits in the receiving country) – Corruption index associated for PPP energy – Number of hours spent by households gathering fuelwood

Possible Indicators for different elements of the energy system

System Element	Insights	Potential Indicators
Consumer service quality	There is a need to move beyond simple notions of 'access' and 'energy poverty' to real metrics for end use service quality, entitlement and access in households and businesses, while accommodating diversity in resources, expectations and needs. Importantly how these contribute to SDG outcome goals.	Systematic tracking of: <ul style="list-style-type: none"> Achieved end-use service quality against basic welfare norms. Affordability of end use service quality (the cost of the service attained rather than the unit price of energy)
End-use efficiency	There is a need to move beyond naïve energy intensity to real energy efficiency indicators, with a concatenated structure of indicators that also highlight structure and activity within households and businesses.	Systematic tracking of: <ul style="list-style-type: none"> Changes in household size, occupancy, and efficiency of key end use applications in households. Changes in economic structure, end use efficiency and value added in industry and commerce. Changes in modal and vehicle structure, activity and end use efficiency in transport.
Distributed cost-reflective utilities	There is a need to identify how utilities can better incentivize consumer demand responsiveness and end-use efficiency as T&D utilities shift from being energy distributors to become capacity managers of diverse central and distributed energy producers.	Systematic tracking of: <ul style="list-style-type: none"> Changes in the actual performance of central supply systems, distributed and end-use energy, within competent life cycle analytical frameworks.
Supply system innovation and sustainability	There is a need to understand how supply side policies and practices can evolve a more sustainable and economically efficient supply system.	Systematic tracking of: <ul style="list-style-type: none"> Changes in supply system value and performance within competent life cycle analytical frameworks.
Resource sustainability	There is a need to understand how diversifying the resource mix, economic trade, and managing environmental nexus impacts can enable a more resilient and sustainable energy system.	Systematic tracking of: <ol style="list-style-type: none"> Metrics for separate and integrated resource (energy water, land, and air) system resilience. Changes in resource (energy water, land, and air) system value and performance within competent life cycle analytical frameworks. Metrics for nexus dynamics.

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