HIGH-LEVEL POLITICAL FORUM ON SUSTAINABLE DEVELOPMENT

POLICY BRIEF #27

INDICATORS AND DATA FOR ENERGY FOR SUSTAINABLE DEVELOPMENT

Developed by:

UNECE, UNECA, UNECLAC, UNESCAP and UNESCWA

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This document is a part of a series of Policy Briefs being developed to support SDG7 review at the UN High-Level Political Forum to be held in July 2018. The objective is to inform intergovernmental discussions by providing substantive inputs on SDG7 and its interlinkages with other SDGs prepared through inclusive multi-stakeholder consultation processes. The development of these Policy Briefs is coordinated under the auspices of the Ad Hoc Informal Multi-stakeholder Technical Group of Advisors on SDG7.

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KEY MESSAGES

There is no common view of what sustainable energy is or how to attain it. Apart from the global challenges regarding the implementation of the 2030 Agenda and other pledges that countries have made, countries have divergent economic development, resource availability and energy mixes embedded in today's national energy strategies. As a consequence, multiple national approaches and outcomes can be found. Nevertheless, if transformation of the energy system is to succeed, choices must be economically and socially rational for each country and be made in the broader context of the economy as a whole. The goal is to enhance quality of life while optimizing the use of resources.

It has become evident in tracking progress toward attainment of sustainable development goal (SDG) 7 that i) the current approach on indicators would benefit from refinements and ii) the capacity to collect relevant data needs to be enhanced and adapted. Adoption of international methodologies both for statistics and indicators are a prerequisite for quality, global coverage, and comparability.

Relevant indicators would measure progress toward the future energy system and address the challenges that countries face as systems become more complex and needs more urgent. Taking such an approach leads to consideration of a broader concept of "energy for sustainable development" which seeks to measure progress towards all energy-related SDGs to reflect the cross-cutting interconnections among the SDGs. Decision-makers will be better informed with a broader range of forward-looking indicators that cut across the 2030 Agenda for sustainable development from an energy perspective. SDG 7 is the energy goal, but energy underpins the 2030 Agenda, and progress needs to be tracked across all energy-related goals. Countries will then be better equipped to take needed actions to ensure goals are met. Figure 1 maps the contribution energy makes to the 2030 Agenda.

Current indicators have been derived from the existing data gathering and reporting infrastructure that emerged from the energy system of the past. In order to inform policies to accelerate the transitions to energy systems that can meet the 2030 Agenda objectives and targets, it will be necessary to develop appropriate indicators for the system of the future, adapt data gathering systems and build the required capacities to collect, analyse, track and report new data and indicators.

Priority Actions

- Adapt existing indicators for SDG 7 to reflect the range of issues on Access, Energy Efficiency, and Renewable Energy.
- Complement reporting on agreed indicators to include indicators for all energy-related SDGs.
- Reinforce and adequately resource energy statistics programmes that monitor and report comprehensive energy variables, and that 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 as the basis to track national energy trends, and that international methodologies are adopted to ensure data comparability.
- Design data collection on energy production and consumption patterns consistent with the desired future energy system. Monitor or make reliable estimates of energy consumption patterns in all economic sectors per energy source and for each of the main end uses, leveraging on national and international expertise and methodologies.
- Develop specialized national energy data observatories to centralize the consolidation, processing and analysis of all developed energy related data and indicators
- Strengthen analytical capacity of the different interactions involving energy policy and climate, especially the water-energy nexus and the water-food-energy nexus, in order to support innovative sustainable policy approaches to address these multidisciplinary energy-related issues.
- Develop appropriate indicators adapted to the system of the future, continue to adapt data gathering systems, and build the 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.
- For energy, when considering indicators, think in terms of a wholly interconnected, complex system in which supply, demand, conversion, transport/transmission interact freely and flexibly to provide energy services to customers. The indicators should support national energy options based on a sustainable development perspective, integrating increased uptake of energy efficiency and renewable energy, encouraging careful management of energy resources, ensuring access to modern energy services, and addressing the needs of energy consumers and energy suppliers.

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. The SDG 7 indicators for energy access are the share of populations with physical access to electricity and the share of populations with access to clean cooking fuels and technology. However, even in countries with 100% or near 100% 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.

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 placing 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 underway in 15 high access deficit countries. The survey and analysis will apply this approach systematically on a large scale. The Multi-Tier Framework methodology is described at https://www.esmap.org/node/55526.

Notably in cold climates, affordability and service quality of heating services, *i.e.,* not electricity, are a particular challenge with the lock-in of older, fossil fuel-based heat infrastructure and poor insulation remaining an important issue. A complementary indicator 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 and energy intensity, in itself, does not reflect differing economic structures, availability of resources, activity levels or climatic drivers for energy use. Energy intensity 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 total primary energy supply (TPES) to GDP, with the latter measured in a way 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. As most governments are more motivated to improve their country's social wellbeing, economic productivity and environmental impacts rather than "saving energy", improving the country's GDP per unit energy productivity is a priority. 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 level indicators to track progress of energy efficiency across sectors. There currently is sub-optimal data availability to calculate energy productivity at the sub-sector level. Such 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 are few good data on energy outputs, particularly in the transportation (vehicle-kilometres travelled) or buildings (square meters of area) sectors. Without the ability to drill down into sectoral and sub-sectoral level, the diagnosis of energy efficiency challenges remains quite coarse. Solving this issue will require the adoption of common methodologies and a concerted cross-sectoral data effort, as often the missing information is from the energy-using sector rather than from the energy sector itself.

Another indicator for energy efficiency relates 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 GTF reports supply side efficiency with thermal generation efficiency and T&D losses using IEA data as complementary indicators.

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 utilising 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% 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, the need to understand primary energy options and their implications is important. Both indicators can be used, but they must be interpreted carefully. A third option would be an indicator that can account for exergy, or entropy. In this case, renewable energy's contribution is evaluated with respect to 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.

For all of the indicators related to renewable energy, they 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 mobilisation of funding, investment in energy efficiency, and foreign direct investment in infrastructure and technology.

Recommendations for Energy Indicators beyond 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 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. For energy, it is critical to think in terms of a wholly interconnected, complex system, in which supply, demand, conversion, transport/transmission interact freely and flexibly to deliver affordable energy services to customers. This perspective applies within regions and sub-regions but also between regions and economic sectors.

Indicators to track energy for sustainable development beyond 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% and will likely remain above 50% 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 must be one 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 if 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. These data are available from the IEA.

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, which are 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 are difficult because of missing data or differences in reporting approaches.

A number of new paradigms have emerged from recent analyses for 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 data gathering infrastructure to ensure that data are available to populate a new set of indicators credibly. The table annexed to this policy brief sets 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 quality of life around the world through the provision of energy services, most notably in the advanced economies, but access and affordability remain challenges. It was noted above the affordability should be included in the measure of energy access. That perspective remains one of kWh sold and bought as a share of household budgets. New approaches from a services perspective will allow those without access to energy to leapfrog 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 a utility's (or service provider's) business model to one of maximizing the margins between the revenues received for services provided (for example, indoor comfort or mobility) and the costs of providing the services (through, for example, efficiency investments). Realizing the potential will require careful reconsideration of and readiness to revisit the existing regulatory, policy, technical, and organizational infrastructure of energy. These are the types of considerations that a more complete set of indicators would be able to inform. The recommendation is that there be an engaged and continuing conversation about what this trend implies, 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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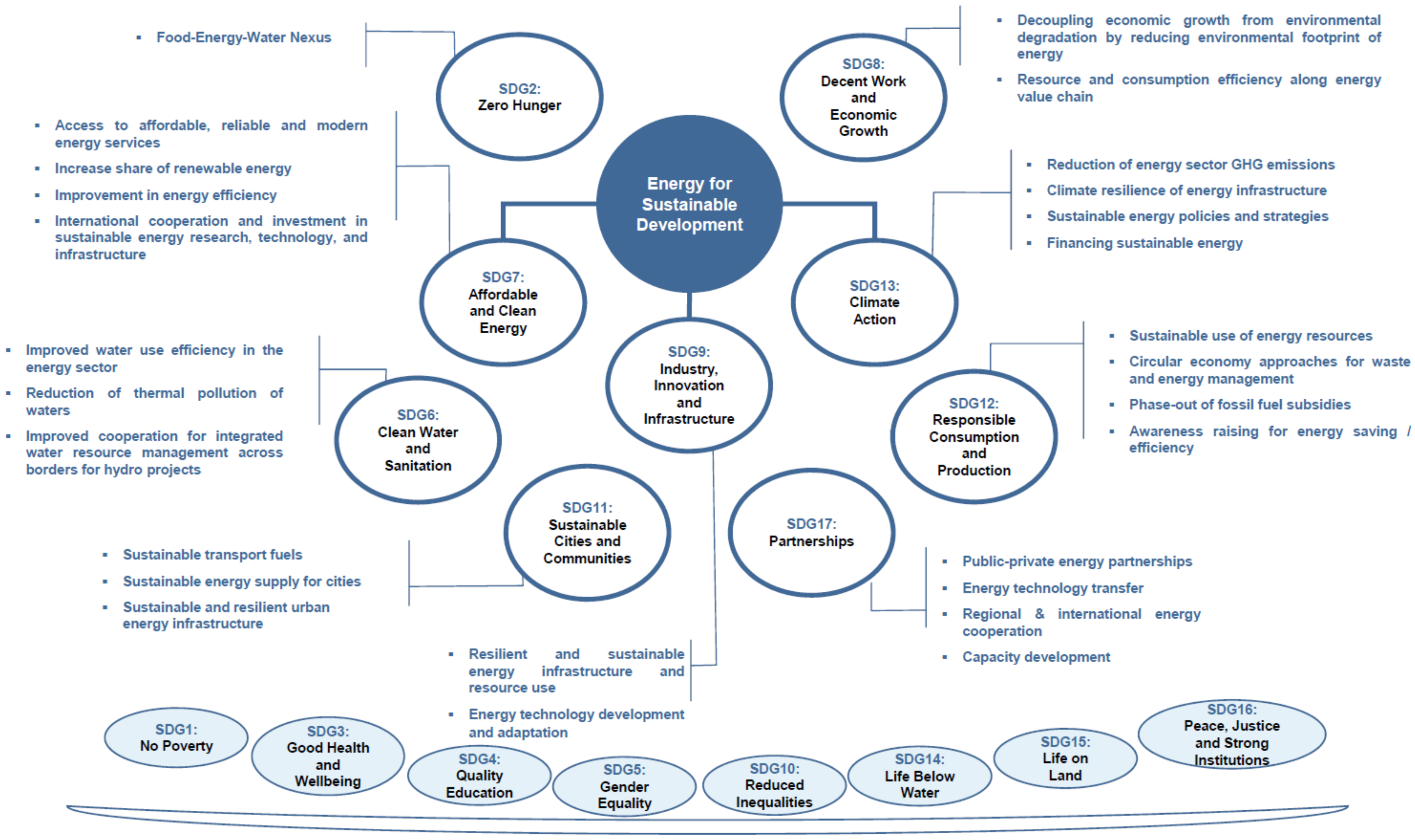
Figure 1 Contribution of Energy to the 2030 Agenda for Sustainable Development



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	

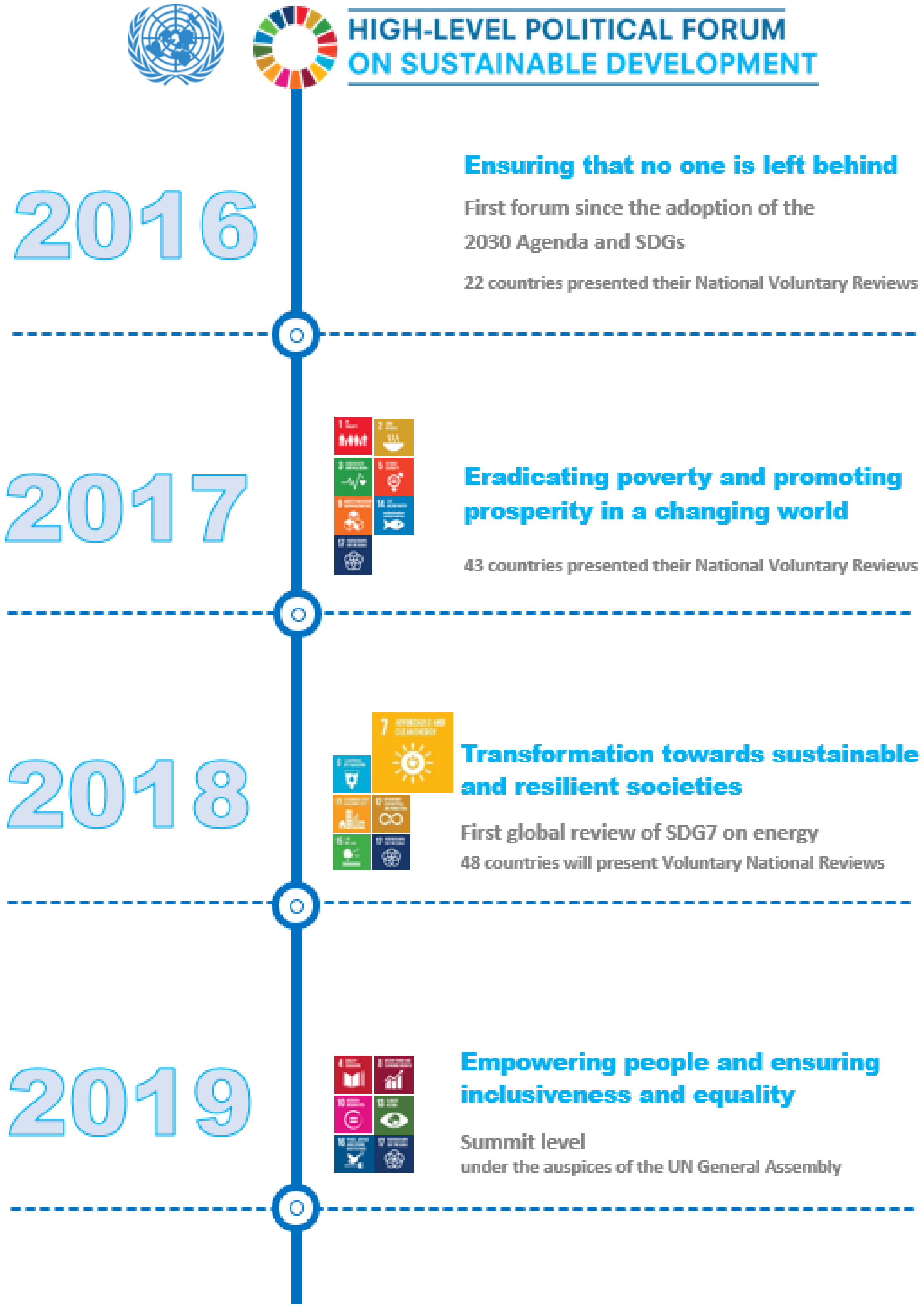
Energy Access	▪ **7.1.1 Proportion of Population with Primary Reliance on Clean Cooking Fuels and Technology**
	▪ **7.1.2 Proportion of Population with Access to Electricity**
	▪ **Affordability, expressed as share of household income spent on energy**
	<u>Suggested areas to formulate additional indicators:</u>
	▪ **Reliability and quality of electricity access**
	    o Number of hours of access to electricity per day (outage rates)
	    o Technical quality (frequency, voltage)
	    o Number of turnoffs by type of consumer
	    o Number of households with access to main grid
	    o Time required to fix disruptions
	    o Number of households with generators
	    o Loss of GDP through interrupted supply (VOLL)
	    o Transmission losses
	▪ **Energy Poverty, encompassing access to and quality of heating and cooling**

Renewable Energy	▪ **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 & 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.e.*, 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
Energy Efficiency	▪ **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 TFC 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.). <u>Sector-specific Indicators (industry, transport, buildings) required disaggregated data</u> ▪ Energy use in buildings (kWh per m^2 of used space) ▪ Efficiency measured as the amount of energy needed to provide demanded energy services <u>Sector-specific Physical Energy Intensity Indicators</u> • Specific energy consumption defined as the amount of energy to produce a tonne of steel
Other Energy Sources	▪ **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	• CO2 emissions from fossil fuel combustion (total and per capita) per TPES and per TFC • GHG emissions of energy sector
Water	• 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
Land	• Land intensity of renewable energy (wind, solar, biomass) • Deforestation caused by use of traditional biomass Suggested areas to formulate additional indicators: o Land management in cities o International land management
Food	• Food waste for biofuels / compost • Fertilizer production • Energy embodied in food exports / imports
Environment	• Energy use per passenger miles Suggested areas to formulate additional indicators: o Air quality / health / exposure; Health impacts of household air pollution o Waste as resource: Recycling; waste to energy
Socio-Economic	• Energy poverty / affordability: household money spent on energy Suggested areas to formulate additional indicators: o Quality of building codes (does it cover humidity, indoor air quality) o Embodied energy in materials and structures (cement, steel, use) o Economic value added of energy exports (benefits in the receiving country) o Corruption index associated for PPP energy o 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: 1. Achieved end-use service quality against basic welfare norms. 2. 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: 1. Changes in household size, occupancy, and efficiency of key end use applications in households. 2. Changes in economic structure, end use efficiency and value added in industry and commerce. 3. 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: 1. 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: 1. 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: 1. Metrics for separate and integrated resource (energy water, land, and air) system resilience. 2. Changes in resource (energy water, land, and air) system value and performance within competent life cycle analytical frameworks. 3. Metrics for nexus dynamics.



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