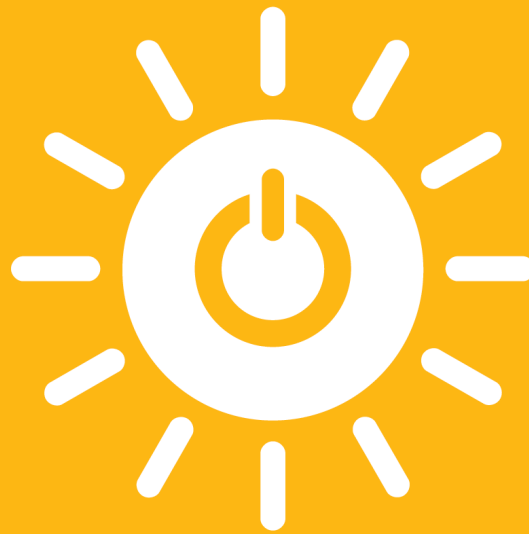


MODULE 5

Sustainable Development

Goal No 7

7 AFFORDABLE AND CLEAN ENERGY



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List of abbreviations

Gross Domestic Product (DGP)
Millennium Development Goals (MDGs)
Sustainable Development Goals (SDGs)

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1. Introduction to SDGs

On September 25th, 2015 world leaders unanimously agreed on adopting an ambitious and more focused plan of action that takes over after the end of mandate of the Millennium Development Goals (MDGs). This new agenda, “Transforming our world: the 2030 Agenda for Sustainable Development” (Sustainable Development Knowledge Platform, 2017) incorporated 17 Sustainable Development Goals (SDGs) defined as well as sub-operationalized with 169 targets to be achieved by 2030. The SDGs attempt to make sustainable development a living reality for everyone. This long-term strategic approach to address global challenges is an important factor of the SDGs.

They seek to realize the human rights of all peoples, to achieve gender equality, reduce poverty, and ensure a better quality of life for all. For sustainable development to be achieved, it is crucial to harmonize three core elements: economic growth, social inclusion and environmental protection. These elements are interconnected and all are essential for the well-being of individuals and societies. Thus, current challenges are typical not only for some countries, but reflect common issues and thus require joint focused interdisciplinary actions that should mobilize all communities. Most governmental programmes and action plans have a rather short life span, and the sustainability of these programmes or action plans are often questionable by changes in the government and political agenda on all levels. In this regard, the SDGs set targets for the long-term, aiming at the next 12 years. This has the potential to minimize the risk of failure during implementation.

1.1 Defining SDG 7

Goal 7, according to the United Nations (United Nations, 2015), focus on ensuring access to affordable, reliable, sustainable and modern energy for all.

The targets of this SDG are:

- By 2030, ensure universal access to affordable, reliable and modern energy services;
- By 2030, increase substantially the share of renewable energy in the global energy mix;
- By 2030, double the global rate of improvement in energy efficiency;
- By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology;
- 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 land-locked developing countries, in accordance with their respective programmes of support.

Each target will have its indicators monitored throughout the next 15 years. These indicators and their whole framework are listed in the United Nations Statistics Division (2017).

1.1.1 Significance of SDG 7

Goal 7 has four aspects: affordability, reliability, sustainability and modernity, as shown in Table 1. Although they overlap, it is necessary to understand their meaning to be able to meet the goal. In summary, SDG 7 is related to social, environmental and economic sustainability, considering the need of access for all, in an affordable and reliable way; allying economic development and technology with reduced environmental impacts and energy consumption.

At first, one may think it is difficult to combine all these concepts. However, this is precisely the real challenge and meaning of SDG 7. Providing affordable energy means to provide energy that everyone can afford in order not to have people lacking access to electricity or other clean energy sources. Nowadays, in many countries, people are unable to afford renewable energy, for example, even though they know it would be important. These technologies tend to have long payback periods and, without incentives, it is a difficult investment to be made.

Tabel 1: Aspects of Goal 7 and its definitions

Dimension	Definition	References
Affordability	Minimising financial costs (although some studies have shown people tend to worry about fairness, justice and equitable cost sharing as well)	Demski et al. (2017)
	Quantifying the share of household income spent on energy	Winkler et al. (2011)
	Effect on household expenses as a result of a product purchase	Riley (2014)
	Indicative of the purchasing ability of the households to buy a particular service	Reddy (2015)
	Depends on raising income levels (and hence purchasing power) and controlling the impacts that impersonal economic forces operating at global levels have on the costs that people face on an everyday basis	UN Chronicle (2015)
Reliability	Depends on a steady supply, robust governance, and an efficient and stable distribution system	UN Chronicle (2015)
	Its evaluation depends on failure-free operation in big data systems in order to predict the occurrence of unpleasant events so that preventive measures can be taken	Kuo and Pan (2017)
	Indicates the continuous supply as well as the quality of end-use appliances	Reddy (2015)
Sustainability	Comprising three main pillars including energy supply diversity, demand management, and environmental impact mitigation	Alsayegh et al. (2018)
	Production, conservation and use of energy sources in ways that promote or at least are suitable with long-term human well-being and ecological balance	Vidadili (2017)
	Providing energy services that meet the economic, social and environmental needs, while recognizing equitable distribution in meeting those needs	Davidson (2002)
Modernity	Access to three forms of energy: less polluting household energy for cooking and heating (including solid biomass fuels and renewable energy sources); electricity for powering appliances and lights in households and public facilities; and mechanical power from either electricity or other energy sources that improve the productivity of labor	Pachauri et al. (2012)
	All sustainable energy must be modern, although not all forms of modern energy are sustainable (e.g. coal)	UN Chronicle (2015)

As shown in Table 1, reliability is another important aspect, and it may seem quite simple for developed countries' residents. The truth is that there is a whole system behind the energy supply to guarantee reliable access, without failure and stops; therefore, many countries have this issue as a priority.

Modern energy is not necessarily a technological energy. Coal, for instance, is considered a modern energy source, since it was at first compared to traditional energy such as firewood and animal feed, and had a huge contribution to the Industrial Revolution (Kander and Stern, 2014). According to the World Bank Group (2017), “emissions and pollution risks from inefficient household energy sources like kerosene and traditional biomass can directly contribute to diseases and premature mortality among the poorest people, who have little or no access to health care”, which is why it is so important to consider the modernity aspect. It is also important to consider that coal can be modern, but it must not be considered sustainable.

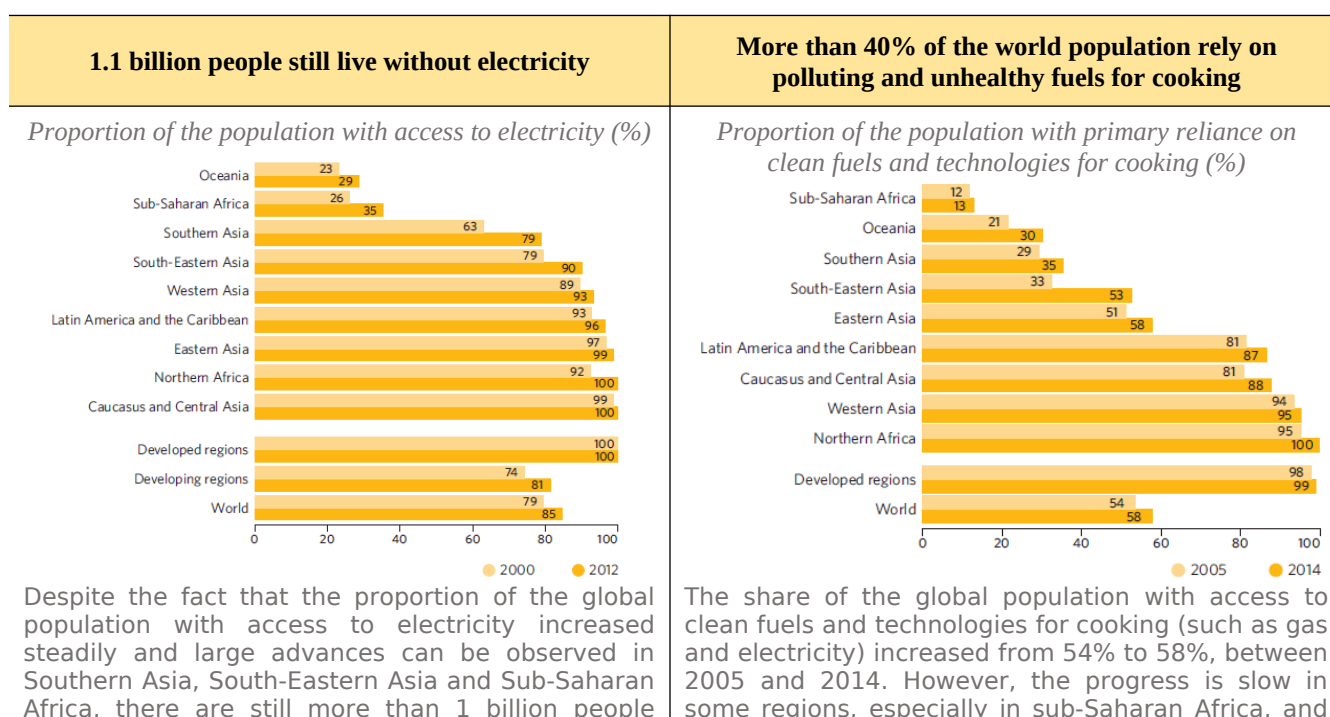
All of these characteristics are intrinsic to the sustainability aspect, working in a way that balances human well-being, reduced environmental impacts and a quality service.

1.1.2 Advantages of SDG 7

Goal 7 recognizes that increasing access to electricity and other forms of energy is fundamental to improving people's lives and communities, hence the SGD focus on energy efficiency and promotion of renewable resources to sustainable development (World Bank Group, 2017).

According to Islar et al. (2017), energy is a central topic in debates around security, climate change mitigation and poverty alleviation, being considered one of the principles in achieving the SDGs. Some key points, as shown in Table 2, illustrate why this SDG is important and why its targets are essential to the world's current situation.

Tabel 2: Key points that justify SDG 7 and its targets

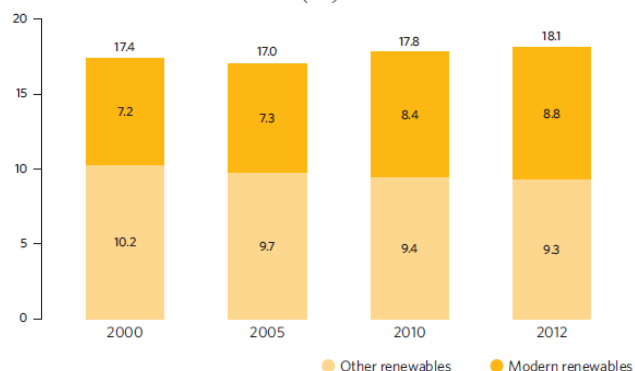


without this service. Most of those that gained access to electricity since 2010 (around 80% worldwide) live in urban areas.

approximately 3 billion people are still relying on polluting fuels and technologies for cooking worldwide.

Use of renewable energy is growing modestly

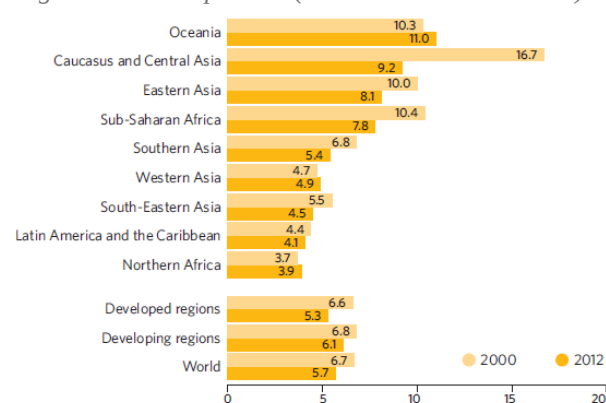
Renewable energy share in total final energy consumption (%)



The share of renewable energy (considering hydropower, solid and liquid biofuels, waste and wind, sun, biogas, geothermal and marine sources) in the world's total final energy consumption had a small increase from 2000 to 2012. On the other hand, modern renewables (which exclude solid biofuels), grew 4% a year between 2010 and 2012 and the contribution of renewables to the electricity sector has grown. Modern renewable sources represented 60% of all power-generating capacity in 2014, and more than 70% of the increase in energy consumption from them between 2010 and 2012 came from developing regions.

Global economic growth is not being decoupled from energy use quickly enough

Energy intensity measured in terms of primary energy and gross domestic product (MJ/2011 US dollars PPP)



Energy intensity represents how much energy is used to produce one unit of economic output. This global indicator improved by 1.3% from 2000 to 2012 falling from 6.7 megajoules per unit of GDP (2011 US dollars PPP) in 2000 to 5.7 in 2012. Industry and transportation sectors were the largest contributors to reduce the energy intensity, due to greater efficiency measures. Nevertheless, this progress is only two-thirds of the pace needed to meet one of the targets of Goal 7. Another interesting data is that about 68% of the savings in energy intensity between 2010 and 2012 happened because of developing regions, with Eastern Asia as the main and largest contributor.

(Source: Based on United Nations, 2016)

These data are also presented in the last report from the United Nations (2017), which presents the progress towards the SDGs. The evolution in sustainable energy has not been enough to achieve the targets of SDG 7. In order to promote improvements, higher levels of financing and stronger policy commitments are required, allied with the willingness of countries to invest in new technologies on a wider scale. According to the report, the share of renewable energy in final energy consumption grew from 17.9% to 18.3%. Most of it is from water, solar and wind power, contributing to renewable electricity. Solar and wind energy represent a minor share of energy production and consumption, but they have been growing fast. Hydropower is the leading renewable source for electricity generation globally, supplying 71% of all renewable electricity and generating 16.4% of the world's electricity if all sources are taken into account (World Energy Council, 2016). It is indeed positive, since countries are taking advantage of their largest hydropower capacities, mainly China, USA, Brazil and Canada. However, the challenge is to increase the share of renewable energy in the heat and transport sectors, which together account for 80% of global energy

consumption. Most of it comes from non-renewable resources, making these sectors leaders in the contribution to greenhouse gas emissions (Mohamadabadi et al., 2009; United Nations, 2017).

Although the report shows these important data, it is imperative to highlight that the SDGs were established in 2015 and, since then, nations have been focusing on meeting the goals, defining priorities and actions, resulting in high expectation for further progress and better results in the next reports and following years. On the other hand, this report indicates areas that should receive greater focus and incentives, especially those regarding the developing countries and incentive to renewable energy. In this sense, actions of SDG 7 will help people have access to electricity, clean fuels and more efficient technologies, and also improve energy efficiency globally.

Other points observed in Table 2 regard the huge difference between developed and developing regions, specially Oceania, Sub-Saharan Africa, Southern Asia and other regions of Asia, Africa and Latin America. These differences are probably connected to many reasons, such as weather conditions, economy, governance and availability of resources.

The same can be said about access to electricity and to clean fuels. Developed regions have high rates of access, but the world's average is lower (especially for access to clean fuels), which means there are many nations in critical situation, needing urgent action.

Table 2 also shows the slight growth in the use of renewable energy. The share of other renewable resources, such as wood and energy crops, have been decreasing, and it is really imperative to increase the use of renewable energy, as wind and sun power, in order to take advantage of these available resources with a low-environmental impact. At the same time, actions to decrease the energy intensity should be considered. This is a more economic related aspect, but equally important, for being so deeply connected to energy efficiency measures and its success. The results point out to sectors such as industry and transportation, which tend to have a high consumption of non-renewable energy sources, as the ones with higher contribution to reduce energy intensity. These sectors should be the focus of developing countries in order to have more positive results.

1.1.3 Interdependencies of SDG 7

SDG 7 is one of the goals that are more connected to others. That's because all of the activities developed nowadays demand energy: at home, at work, for leisure activities, transportation, sanitation, food production, among others. Even energy production demands energy. Therefore, this goal stands that energy for all is essential. The main SDGs associated to Goal 7 are:

- Economic Growth (SDG 8), since energy is associated with the Gross Domestic Product (GDP);
- Industry (SDG 9), that is one of the sectors with the biggest energy consumption;
- Sustainable Cities (SDG 11), since renewable energy is one of the main topics of sustainable communities;
- Responsible Consumption and Production (SDG 12), especially for the need to encourage energy efficiency and reduction of energy waste; and
- Climate Action (SDG 13), considering the reduction of fossil fuel use and greenhouse gas emissions, as shown in Figure 1.

Many authors support the interconnection between the concepts of climate change, environmental impacts, economic growth, carbon dioxide emissions, technology and energy supply, production, consumption and efficiency (Kramers et al., 2014; Kasman and Duman, 2015; Bloch et al., 2015; Lund et al., 2014; Alshehry and Belloumi, 2015).

Figuur 1: Connection between SDG 7 and others



Through SDG 7, it will be possible to integrate energy production and the conservation of natural resources, besides the development of renewable energy and strategies to climate adaptation.

1.1.4 Challenges in the implementation

According to Bowen et al. (2017), the SDGs have three major challenges: bring together the stakeholders, make trade-offs difficult¹ and build accountability for action. Lucci (2015) points

¹ The overlap of SDGs can be seen from two different approaches. On the one hand, it is positive, since one action can contribute to different targets and more than one SDG. On the other hand, some actions needed to meet a goal can be harmful to another one. As far as energy is concerned, the incentive to clean energy sources

out other challenges: the lack of good data to be monitored; how to prioritise targets according to the needs of each region; the need for investments and financial support; the need of local governments to have technical capacity to plan and manage things; and the commitment local governments have to make to meet the goals.

These aspects apply very well to SDG 7. Besides that, the biggest challenges of this goal are to ensure universal access, increase the share of renewable energy and efficiency measures used globally and promote international cooperation. All these challenges are linked to the need for investment and financing, which makes it even more difficult to pursue equity, especially in developing countries. Additionally, making all nations work together in the targets and cooperate to each other are difficult points since the actions depend on the priorities of each region and their available financial resources. In many developing countries the lack of efficiency in energy used is a big challenge. According to Oyedepo (2014), to diversify energy sources and to adopt new available technologies are solutions for this problem, by developing strategies to save energy on the demand side, by promoting efficiency improvements in the energy production and by replacing fossil fuels by various sources of renewable energy.

According to Pachauri et al. (2013), analyses exploring pathways to energy sustainability and quantifying the potential costs and benefits are limited, but financial resources and dedicated policies are the way to promote lower costs for modern cooking fuels and increased electricity access.

On the other hand, although the financial need is also a critical point in this matter, the limited sources of fossil fuels, in addition to the need to reduce greenhouse gases emission, have made renewable resources attractive in world energy-based economies (Ellabban et al., 2014). The challenge is to increase its use in the global energy mix, by gradually reducing fossil-fuel use, therefore the commitment of local and global governments is essential, in both developing and developed countries. These challenges have to be overcome gradually, as nations establish their priorities and consolidate their actions to reduce energy waste, increase use of renewable energy sources and invest in sustainable energy for all.

1.1.5 Future perspectives

As the global population rises, cheaper and more efficient energy will be demanded. The energy sector is responsible for the largest portion of the world's greenhouse gas emissions, especially because of production based on fossil fuels. Therefore, this consumption pattern has to change, being replaced by a substantial increase in renewable energy production across the world and cost-effective standards for lower electricity consumption.

In order to achieve the aims of SDG 7, nations need to act together in order to:

and energy security by using food crops to biofuel production can threaten food security, being opposite to the target of SDG 2 (Zero Hunger), as well as water security (SDG 6), which could be threatened by decisions to build hydropower for energy security and greenhouse gas mitigation (Patterson, 2015).

- a) Enable strategies for action: the targets have to be prioritized, otherwise it will not be possible to succeed in any of them and, therefore, it is indeed necessary to define what has to be done first, and then the subsequent steps;
- b) Reinforce governance, partnerships and coordination: although the priorities of each target change from one region to another, different countries can organize themselves in order to act together, sharing responsibilities and progress;
- c) Promote accountability and financing: these are especially important in SDG 7 considering the high investments demanded for implementation of renewable energy and efficiency measures and technologies;
- d) Schedule monitoring, follow-up, reviews and reports: this step is essential, since countries have to control their progress and eventually change approaches and initiatives, checking what is working and what is not within the next years.

These future perspectives work like a checklist, in which each nation has to assess their gaps, define priorities (like reduction of greenhouse gas emissions, increase in electricity access, increase in renewable energy production, implementation of energy efficiency measures, among others), organize a digital system for the monitoring of indicators, establish a monitoring plan and frequency, control progress, redefine targets and then meet the goal.

1.2. Good practices

Affordable clean energy may seem a worldwide trend, as many projects and actions take place due to climate change. This is sure a trend, but in different levels. According to the United Nations (2018), in the years 2015, 2016 and 2017 (178, 147 and 177 US dollars billion respectively), the developing countries invested more in renewable energy as the developed countries (146, 126, 103 US dollars billion respectively). Before 2015 the majority of investment was done by the developed countries. Recent practices show that countries need to identify their strengths in order to invest properly.

In Namibia, the city of Lüderitz, the strong winds attract people from all over the world to practice wind- and kitesurf. It made sense therefore to have near the city a wind power plant, which was the first in Namibia. Besides that, there are more than 300 days with sun in the country, which contributed to the solar power plant installed in Okahandja (IRENA, 2019).

In Western India, a big transmission project costing 1.8 billion US dollars is planned in order to support wind and solar power projects. This transmission project located in the states of Maharashtra, Gujarat, and Madhya Pradesh is planned to support India in achieving the operational capacity target of 100 gigawatts of solar power and 60 gigawatts of wind energy by March 2022 (CleanTechnica, 2019).



1.3 Exercises

In this section, the module rolls out a proposed set of exercises that teachers can conduct among their students to eventually produce knowledge manifested in written articles, videos and the type of presentations that help disseminate ideas and solutions regarding SDG 7. Each exercise is presented with an example (in bold) accompanied by some material from which the lecturer can commence the exercise.

1.3.1 Exercises

CleanEnergyMakingSense: This exercise tackles teachers' and students' perceptions. For example: **as SDGs are finalized and in process of execution, how do you see yourself, as teacher, and your students, making sense of SDG 7?** Sub-questions that you can pose include: To what extent is SDG 7 feasible?; Which are the difficulties in implementing an affordable and clean energy in your community?. [This exercise is in the PPT \(1.3 Exercises on SDG 7: CleanEnergyMakingSense slide 20\)](#)

Affordable and Clean Energy surroundings: Map SDG 7 in relation to all other SDGs. You can use Venn diagrams and radar chart on this activity. Questions to be raised in this activity could be, for example: How strong is the link between SDG4 and SDG7? Or: How can SDG7 on affordable and clean energy support the completion of SDG1? Or: How does SDG7 foster healthy lives and promote well-being for all at all ages (SDG3)? The overarching question in this activity is: **How can an integrative approach be adopted to tackle SDG7 in tandem with other SDGs?**. [This exercise is in the PPT \(1.3 Exercises on SDG 7: Describing links with other SDGs, slide 21\)](#)

Data4CleanEnergy: Gather and analyze global, regional, national and local data on SDG7. Begin for example with data from the UN Sustainable Development Knowledge Platform², then go to other analytical platforms such as Eurostat³. You can also inspect the website Sustainable Energy for all⁴ and International Energy Agency⁵. Another options to collect data on clean energy are the International Renewable Energy Agency (IRENA)⁶, the

² Data on SDG7 from the UN Knowledge Platform: <https://sustainabledevelopment.un.org/sdg7>

³ See https://ec.europa.eu/eurostat/statistics-explained/index.php/Renewable_energy_statistics here:

⁴ See here: <https://www.seforall.org/heatmaps>

⁵ See here: <https://www.iea.org/>

⁶ See here: <https://www.irena.org/>

SDG Tracker⁷, or even the Data bank from the World Bank⁸. Analysing the data under the following question is one example: Which are the positive and negative effects of improving the SDG7? Also, students could gather data in their community (classroom / university / school / neighborhood / house) and analyze the trends in both a qualitative and quantitative manner to find out major narratives, frequencies, correlations and causalities, and see how well the data is situated in comparison to the local (if available) or otherwise national data from the other platforms. Another purpose of this exercise is to see the extent to which the data collected can converge with the timeframe and expectations set by SDG7. [This exercise is in the PPT \(1.3 Exercises on SDG 7: Gather and analyse data on SDG 7, slide 22\)](#)

In case, however, you decide doing the comparison between your locally gathered data and institutional data, decide first on a baseline from the data collected from the other institutions and platforms since 2015. Thereafter you can compare this baseline with your local data in terms of rates of change, i.e. frequency of progress in the SDG targets according to the SDG indicators. Noteworthy: present the data in a visually appealing way.⁹ The baseline data from both venues (institutional and local) would be useful for a future monitoring and evaluation assignment you could do with the students to see how far there is progress or retraction.

Localizing4Development: How can you identify the benefits of SDG7 at your community (classroom/university/school/neighborhood/house) and at individual level? Localizing SDG7 comes with challenges. Thoughts to reflect on, for example, include: What are the benefits of countries promoting affordable and clean energy compared to countries with no such view in developing SDG7? Discuss pros and cons of such approach. Picking specific countries/states as examples when comparing – and then setting them into context with your respective local system will help in providing an understanding for where changes can be lobbied for. Taken altogether, contextualizing the SDGs in its local context is an important assignment prior and along the road of implementing SDG7. [This exercise is in the PPT \(1.3 Exercises for SDG 7 – Localizing4Development on SDG 7, slide 23\)](#)

Policy Briefs: In this activity, the teacher will **encourage writing policy briefs on any topic pertinent to affordable and clean energy as identified by SDG7**. Students will follow a similar structure as stipulated in policy briefs by international organizations and national agencies (see example by the UN-Energy¹⁰ or the International Solar Energy Society

⁷ See here: <https://sdg-tracker.org/energy>

⁸ See here: <https://databank.worldbank.org/data/home.aspx>

⁹ You can see example of data visualization for interlinkages (and the respective SDG per country) on this platform: <https://sdginterlinkages.iges.jp/visualisationtool.html>.

¹⁰ See <http://www.un-energy.org/>.

(ISES)¹¹. This will serve elevating the students' policy-related writing skills in addition to directing them towards formulating their own manuscript of briefs on affordable and clean energy issues of their primary concern. They also develop grounded realization of the challenges of implementing SDG 7 at all levels, from the international all the way to the local level. [This exercise is in the PPT \(1.3 Exercises for SDG 7 – Policy Briefs on SDG 7, slide 24\)](#)

@CleanEnergy: Drive your social media platforms in ways that promote clean energy needs awareness in your community (classroom/university/school/neighborhood/house). For example: that can be through simple daily/weekly photo campaigns as well as conversations that bring the default behaviors of students that gravitate towards constantly viewing social media together with the purpose of the exercise; that is, bringing their awareness closer to what they can do to promote clean energy awareness for all in their community. You may firstly check for already existing campaigns on clean energy awareness and discuss about them. [This exercise is in the PPT \(1.3 Exercises for SDG 7 – @CleanEnergy, slide 25\)](#)

CleanEnergyPreneurs: Finding stories and instilling a sense of belonging by bringing together those working on clean energy quests can be motivating to those doing the work, inspiring to the community and the entire world. For example, you can use **vlogs, blogs** and **journals** such as fairs and expos to promote this exercise on **promoting SDG7**. It will also allow those good ambassadors of clean energy from the business community to network and widen their perspective with each other and the broader communities. [This exercise is in the PPT \(1.3 Exercises for SDG 7 – CleanEnergyPreneurs, slide 26\)](#)

BreakingSilos: Taking its name from the silo-effect, this activity promotes **actively thinking and writing on SDG7 from the wide variety of sciences and arts** out there. As a lecturer, you could be interested or expert in literature, hence approaching SDG7 from a more philosophical perspective; another could be interested in addressing education issues in SDG7 from a managerial perspective. For example, a question you could pose is: Using a cost-benefit analysis, what benefits are there for implementing SDG7? Another example could be: If you are a natural scientist, what indicators might there be missing to better include sciences in clean energy? This exercise intends to break through silos of each discipline and stimulate cross-disciplinary discussions on clean energy. [This exercise is in the PPT \(1.3 Exercises for SDG 7 – BreakingSilos, slide 27\)](#)

¹¹ See <https://www.ises.org/content/global-100-renewable-energy-campaign>.



1.3.2 Assessments

Below is an outline of several different questions related to the SDGs in general, and to SDG 7 in particular, that help assess your understanding of the topic and the interlinkages and challenges. These questions are also designed to act as questions for your students to discuss the topic further and/or prepare presentations on them.

Questions:

1. Discuss the pros and cons of the term “sustainability”. Do you believe that sustainability is a new philosophy? Or is it actually a very old one well known to our ancestors?
2. Define the SDGs and environment they derived from, i.e. what are the main advancements (positive or negative) compared to the Millennium Development Goals (MDGs) and the Education for All initiative?
3. Discuss four main difficulties you see in implementing the SDGs.
4. With regard to reporting and measuring outcome and impact, assess if the targets are well defined and what institutions have indicators available.
5. How does SDG 7 interlink with other SDGs? What are positive and negative interrelations, and how do they impact human well-being?
6. Which are the SDG 7 benefits for communities, countries and business in general?
7. Which are the main difficulties you identify in the implementation of SDG 7 in your country?
8. List some examples of positive successes over the last two decades in promoting affordable and clean energy in Low and Middle Income Countries.

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