

# ON SYNERGIES AND CONFLICTS BETWEEN THE SUSTAINABLE DEVELOPMENT GOALS (2016-2030) AND RENEWABLE ENERGY SOURCES FOR EDUCATION OF AND BY SUSTAINABILITY

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## Abstract

*In September 2015 the United Nations (UN) accepted the Sustainable Development Goals (2016-2030) for mankind, including 17 Goals and 169 detailed Targets. Sustainability is understood in the wider sense by the document, considering society and economy not just as conditions for environmental sustainability, but as equally important pillar of the „building of sustainability”. Fulfilment of these goals and targets needs active participation of present and future generations, hence education of these tasks is inevitable. The aim of the research is to specify those goals and detailed targets in which renewable energy sources are involved. The latter is just one aspect for bringing the whole complex closer to the adults and youngsters to educate. This topic, however, is characterised by three features that make this aspect appealing: renewable energies are (i) fast developing, (ii) future oriented by saving the environment and (iii) they represent relatively new pieces of knowledge, so contemporary information should not fight with older learning. Before turning to these goals and targets, a reasonable classification of the 17 goals, listed without any systematic order in the UN document, is provided. The presented classification of the goals recommends the following groups: (i) Primary needs of humans (Goals 2, 3, 6 and 7) (ii) Equality between humans (1, 4, 5 and 10), (iii) Efficient, sustainable production (8, 9, 12 and 13), (iv) Landscapes in danger (11, 14 and 15) and (v) Worldwide cooperation (16, 17). From these Goals, No. 7 (affordable and clean energy) and No 13 (climate action) are in full synergy with the aim of extended renewable energy utilisation, but No 2 (zero hunger) might be in contradiction with extensive land use for bio-energy. If consumption of timber for bio-energy continues to be intense than No. 15 (life on land) may also contradict to other goals of sustainable development. Six further targets are identified as related to renewable energies without relatedness of the complete goals. So, we may consider 14 targets belonging to 9 goals to be related to energy sources. The recommended classification of the goals and quotations of the energy-relevant targets are illustrated by some world-wide and Hungarian indicators. Being acquainted with these objectives is useful for all youngsters, presented at their level of knowledge, and it provides a good basis to refresh one's activity expressed in the environmental education.*

**Keywords:** climate change, environmental education, renewable energy, sustainable development.

## Introduction

In its Summary Report the 8<sup>th</sup> World Environmental Education Congress (WEEC, 2015) offered “possibilities for education and learning for a transition away from ... global systemic dysfunction and towards a healthier, more equitable and balance way of living. Not by propaganda, force or prescription but rather by discovering, (re)connecting, questioning,

*disrupting, experimenting, reflecting and, indeed, continuous learning.*” This quotation is the main motivation of the present research, aiming to recommend the Sustainable Development Goals (2016-2030) for educational purposes.

Since its establishing, the UN has tasked itself with providing for the peace and prosperity of all people on Earth, as well as ensuring the equitable distribution of earthly goods. Sustainable development as a concept entered the public consciousness during the second Earth Summit (Rio de Janeiro, 1992), where the UN affirmed the program titled *Tasks for the 21st Century (Agenda 21)*. A few years later, in the year 2000, world leaders formulated eight main goals for the period from 2000 to 2015, which became known as the Millennium Development Goals (MDG). Environmental sustainability was only one of the eight goals listed in the document.

In September 2015 the United Nations (UN) accepted the 2030 Agenda for Sustainable Development (SDG) for 2016-2030, including 17 Goals including 169 detailed Targets. This latter document is in the focus of the present study. For comparison of these goals with other relevant United Nations documents see the review by Vladimirova, K. and Le Blanc, D. (2015). Financial aspects of the majority of the goals are considered by Klapper et al. (2016)

The aim of the paper is to provide information on the targets related to renewable energy sources, chosen as a possible example to serve as a field where the related targets can be exposed. Many other foci could have been selected, but this topic, the renewable energy sources are characterised by three features that make this aspect appealing: renewable energies are (i) fast developing, (ii) future oriented by saving the environment and (iii) they represent relatively new pieces of knowledge, so contemporary information should not fight with older learning.

Possible educational aspects related to the SDG do not directly follow from their content, but four aspects can be recommended as possible ways of using SDG and related knowledge for teaching *of and by* sustainability. These aspects are as follows:

- (i) The SDG (2016-2030) are worth knowing for all pupils of ca. 15 years or elder as long term tasks for everyone on this Globe. One can use these goals and targets to emphasise relative development of a given country or region presenting national sustainability indicators.
- (ii) Especially in higher education it might be useful to collect the related targets to a given wider topic, e.g. as it has been done above for renewable energy sources. In this respect, renewable energy is just a possible field to specify the rather wide set of SDG. For this, motivated audience it is also worth demonstrating how the concrete “number.number” targets are mutually connected with the background and pre-condition type “number.letter” type targets.
- (iii) It is useful to apply the SDG-s also for counteracting the often experienced rather selective topical selection among the various problems by the public media. Some problems are over-emphasised by the various channels and home-pages, whereas others are not represented at all. Having consequently rising all the problems for the adult or younger audience, these problems might be adequately weighted. Furthermore, the teachers should also be active in preparation to introduce the SDG or their selected topics for the given group of pupils, since the written targets themselves are not interesting enough to attract their attention. Hence, proper illustrations of global or national character should be found by the teachers, as well.
- (iv) Finally, the SDG-related statements and examples are suitable for supporting selected topics of school-subjects. E.g. trigonometric functions in mathematics can be demonstrated by solar collectors, i.e. one kind of renewable energy sources. Steepness of the surface in geography can be illustrated by availability of water energy. Photosynthesis in biology and fermentation in chemistry are clearly connected to bio-energy. Another possibility is improvement of the key competences. Application of the above illustrations can themselves be used to improve *Mathematical Competence* and *Competences in Natural Science and*

*Technology.* The *Digital* and the *Foreign language competences* can be developed by asking the pupils to search the appropriate targets in a given topic. Similarly, *Communication in the Mother Tongue* together with their *Learning to Learn* competences can be improved simply by understanding and memorizing the goals and targets. *Social and Civic Competences* may be developed by personal participation in some related voluntary activities concerning e.g. poverty. This is how sustainability is not only an important topic to be educated, but also a useful contributor to reach other aims of education.

Aspect (i) is directly illustrated below, as the SDG (2016-2030) are grouped according to the themes of the goals, intending to make them easily understood and learned. Furthermore, examples from Hungary are presented for relating the global goals and targets to local condition. First part of aspect (ii) is illustrated by selecting all targets that are directly or indirectly related to the renewable energy sources; i.e., a quickly developing field of both technical and environmental importance.

Examples for using climate change to support selected school subject, similarly to that described above in aspect (iv) is collected by Pajtok-Tari et al. (2011) and for improving key competences by climate change by Uto-Visi (2011).

### **Methodology of Research**

There is no empirical methodology behind the classification of the SDG goals and selection of the renewable energy related targets. Classification of the 17 Goals is rather obvious, based on the content of the Goals. It is rather surprising why the original document does not contain this, or any other grouping. Lack of structure makes the 17 goals more difficult to colligate and to memorise.

Selection of the renewable energy related targets is based on understanding of the issue searching for directly and indirectly related targets. The directly related targets could possibly be selected by another author, whereas for indirect relations there might be some differences. The present selection involves those indirectly related targets which are technically or environmentally connected to the energy production and consumption.

The selection of global and national illustrations is not supported by any scientific concept. They intend to present important issues, but their number could be much larger still without the hope to be complete. In case of educational application of the classified goals, it is the option (and responsibility) of the teacher to select a topic within whole scope of the SDG and also to choose illustrations being accepted with empathy and understanding by the given audience.

### **Classification and internal structure of the Sustainable Development Goals**

The goals for the years between 2016 and 2030 are logically separate, but no internal logic is evident in their numbering. Original colours of the pictograms do not help in this regard, either (*Figure 1*). Note that these pictograms exist in different versions, especially for Goal 3, 9 and 15.



**Figure 1: The summarizing pictograms of the 17 Goals (Harvey, 2016).**

Nonetheless, it is not difficult to discover a logical structure of the goals. Based on this, the 17 goals can be assigned to one of five groups, as follows in Table 1.

**Table 1. Grouping of the 17 Goals (2016-2030). All original texts are denoted by ("··"):**

Group of Goals	Numbered Goals G
Basic human needs	"2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture." "3. Ensure healthy lives and promote well-being for all at all ages." "6. Ensure availability and sustainable management of water and sanitation for all." "7. Ensure access to affordable, reliable, sustainable and modern energy for all."
Equality and justice	"1. End poverty in all its forms everywhere." "4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all." "5. Achieve gender equality and empower all women and girls in their social role." "10. Reduce inequality within and among countries."
Efficient, sustainable economy	"8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all." "9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation." "12. Ensure sustainable consumption and production patterns." "13. Take urgent action to combat climate change and its impacts, acknowledging that the UNFCCC is the primary international, intergovernmental forum for negotiating the global response to climate change."
Protecting vulnerable environments	"11. Make cities and human settlements inclusive, safe, resilient and sustainable." "14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development." "15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss."
Cooperation towards common goals	"16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels." "17. Strengthen the means of implementation and revitalize the global partnership for sustainable development."

The scope of the Sustainable Development Goals, mankind should solve in the next 15 years, is much wider than the initial concept of environmental sustainability (e.g. Goodland and Daly, 1996). Society and economy are not only preconditions of ensuring environmental sustainability, but both economy and society contribute to the set of problems to solve. A recent survey of simple and more complex concept of sustainability is provided by Kiss and Morelli (2015).

Among the above grouping, the only goal with no non-obvious categorization was Goal 13, which promotes urgent action to combat climate change. The reason of doubt is that this is the only environmental problem which is represented by an individual goal. All other problems are tackled in connection with the problems they cause. As such, it could also be an individual group, but to avoid a group with one single goal, it is listed in the *Efficient, sustainable economy* group.

The 17 goals, listed above, are divided into 169 targets. 126 of these targets have measurable, numeric indicators that are to be reached by a specific year (usually 2030, but in some cases as early as 2020). The remaining 43 targets are denoted with a combination of a letter and number. These targets promote an awareness-, institutional- or financial foundation for improving the state of the issue in question.

The following targets of Goal 1 are examples of both types:

“1.1 By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than \$1.25 a day. “

“1.b Create sound policy frameworks, at national, regional and international levels, based on pro-poor and gender-sensitive development strategies to support accelerated investments in poverty eradication actions.”

Note that the document includes the 5 P's: *people, planet, prosperity, peace, partnership*, which is stated to be the key to the document (SDG, 2015: p. 2). However, these concepts cannot be consistently seen throughout the goals. The first two groups of the above classification, *Basic human needs* and the *Equality and justice* deal really with *people*. The next two groups, the *Efficient, sustainable economy* and the *Protecting vulnerable environments* fit to *prosperity* and *planet*, but *peace* and *partnership* are related to the smallest group, *Cooperation towards common goals*.

## Goals and targets synergising or conflicting with renewable energy sources

This section describes which goals and targets are related to renewable energy sources. The first sub-section includes the two goals that synergise and mutually support the use of renewable energy sources. In contrast, there are two goals which can conflict with this objective. Finally, the third sub-section will contain the targets indirectly related to renewable energy sources. The three subsections will only include quantitatively measurable targets.

### *Synergistic Goals*

*Table 2* lists the two goals demonstrating obvious synergy with renewable energy sources, as well as their specific targets. With respect to renewable energy, the three most important goals are universal access, increasing the share of renewable energy, and doubling the global rate of improvement in energy efficiency (i.e. achieving the same result by using less energy).

Uniquely, for Goal 13, the “number.number”-type targets are also general in nature. Strengthening adaptive capacity, integrating climate change measures into national strategies, and the single target regarding improving education and institutional capacity are all prerequisites to non-defined target states.

**Table 2. Goals in synergy with renewable energy sources, and the relevant targets (SDG, 2015).**

7.	“Ensure access to affordable, reliable, sustainable, and modern energy for all”
7.1	“By 2030, ensure universal access to affordable, reliable, and modern energy services”
7.2	“By 2030, increase substantially the share of renewable energy in the global energy mix”
7.3	“By 2030, double the global rate of improvement in energy efficiency”
13.	“Take urgent action to combat climate change and its impacts, acknowledging that the UNFCCC is the primary international, intergovernmental forum for negotiating the global response to climate change”
13.1	“Strengthen resilience and adaptive capacity to climate related hazards and natural disasters in all countries”
13.2	“Integrate climate change measures into national policies, strategies, and planning”
13.3	“Improve education, awareness raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction, and early warning”

#### *Conflicting Goals*

Another two goals, specifically ending hunger (Goal 2) and protecting terrestrial ecosystems (Goal 15), may conflict with the renewed growth in bio-fuels. In both cases, there is a single specific target that can potentially conflict with the use of these types of fuel (*Table 3*). Any given plot of land, can only be used simultaneously for food and energy source production if the plant in question is edible (target 2.3). It is possible that terrestrial ecosystems do not become a source of conflict. If production does not grow faster than the natural growth rate, and if the desire for rapid growth does not stress the natural forest ecosystems, even when taking climate change into account, then this source of conflict can be avoided (target 15.2).

**Table 3. Goals conflicting with renewable energy sources, and their relevant targets (SDG, 2015).**

2.	“End hunger, achieve food security and improved nutrition, and promote sustainable agriculture”
2.3	“By 2030, double the agricultural productivity and the incomes of small-scale food producers, in particular women, indigenous people, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets, and opportunities for value addition and non-farm employment”
15.	“Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss”
15.2	“By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests, and increase afforestation and reforestation globally”

#### *Other Relevant Targets*

We have found 6 further targets (*Table 4*) where the relationship to renewable energy sources does not extend to the entire goal in question. We can assess four of the targets as relevant to renewable energy sources because by using renewable energy sources, it is possible

to greatly reduce general and specific environmental impacts (3.9, 11.6, 12.4 and 14.3). For target 12.5, biogas production can be considered a possible solution to waste management. Renewable energy sources can contribute to target 9.4 by allowing for environmentally sound industries that require significant research.

**Table 4. Other targets relevant to renewable energy sources (SDG, 2015).**

3.9	"By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water, and soil pollution and contamination"
9.4	"By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, all countries taking action in accordance with their respective capabilities"
11.6	"By 2030, reduce the adverse per capita environmental impact of cities, by paying special attention to air quality, municipal and other waste management"
12.4	"By 2020, achieve environmentally sound management of chemicals and all wastes throughout their life cycle in accordance with agreed international frameworks and significantly reduce their release to air, water and soil to minimize their adverse impacts on human health and the environment"
12.5	"By 2030, substantially reduce waste generation through prevention, reduction, recycling, and reuse"
14.3	"Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels"

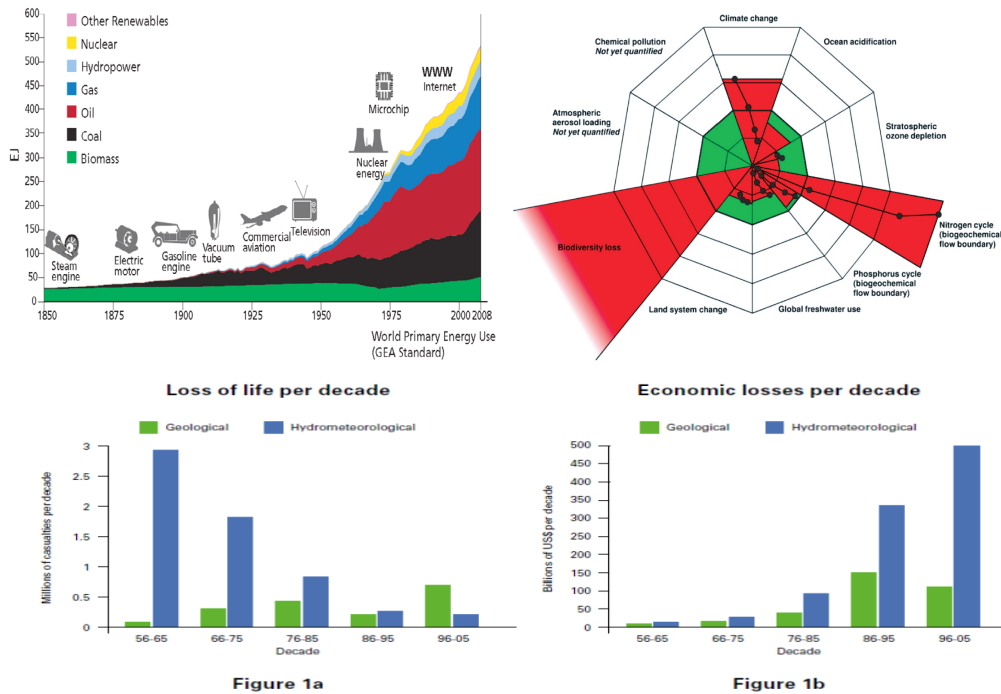
### Indicators Supporting the Goals and Targets

#### *Global Indicators*

For this section, considerations of space only allow us to use a single, combined set of diagrams to display the reasoning for the above targets (*Figure 2*). The diagram for target 7.2 shows that only bio-energy and water power (which has been highly utilised since the early 20<sup>th</sup> century) are significant contributors to the total energy mix. The remaining four modern forms of energy (solar, wind, geothermic and ocean) are barely visible above the nuclear portion of the graph.

For the list regarding target 12.4, the following problems are found, going clockwise: climate change, ocean acidification, stratospheric ozone depletion, nitrogen-cycle, phosphor-cycle, global freshwater use, land system change, biodiversity loss, atmospheric aerosol loading and chemical pollution. From among these, biodiversity loss and the nitrogen cycle have already caused irreversible harm. The effects of climate change are highly significant, but are not yet irreversible. Regarding the other effects: processes remaining within the green section are not yet dangerous, but those extending into the white portions of the web are. (Effects of pollution are spatially localised.)

Finally, regarding target 13.1, we can state that in the last 50 years, the human casualties of hydrometeorology catastrophes have been reduced by several orders of magnitude, despite the fact that the economic damage incurred has not been reduced at all. This shows us that not nature that has become milder; rather, the humanity that has learned to protect human life. It is unfortunate that the same trend does not hold for geophysical catastrophes, which continue to cause great and unavoidable devastation in many parts of the world, albeit in completely erratic time intervals.



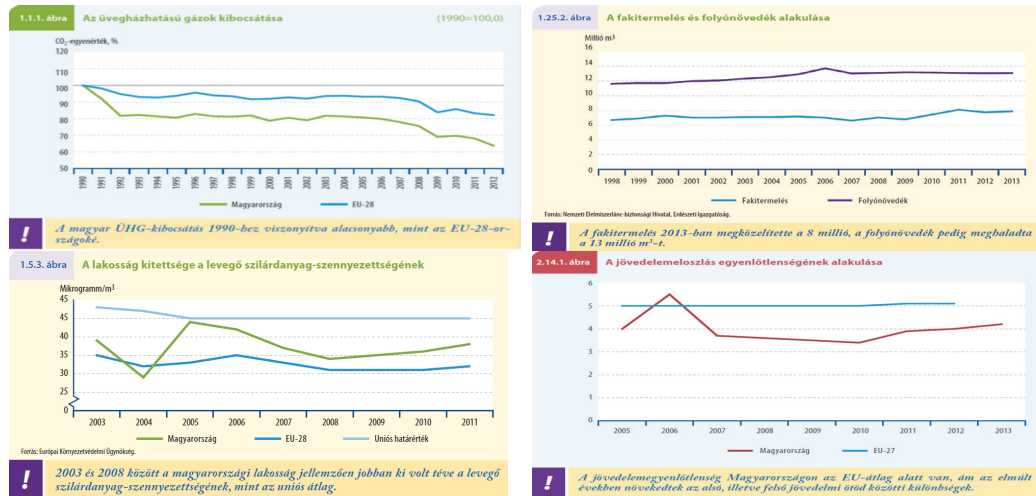
**Figure 2: (Top left, for target 7.2): World Primary Energy Use. (Top right, for 12.4): the most critical environmental issues. (Bottom, for 13.1) Sources: for the top row, GEA (2012), for the bottom row, WMO (2015): page No. 10.**

*Indicators in Hungary*

On March 25 2013, the Hungarian Parliament ratified the National Strategy for Sustainable Development Framework. The Hungarian Central Statistical Office (KSH) published the indicators quantifying the realization of said strategy in 2015. Of the publication's 100 indicators, 33 pertain to the environment, 44 to society, and 23 to the economy.



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**Figure 3: Some Hungarian indicators relevant to energy usage: (upper left) greenhouse gas emissions as compared to the 1990 baseline, (upper right) wood production and growth trends, (lower left) atmospheric aerosol concentrations, and (lower right) proportional differences in the financial income between the richest and poorest 20-20%. Egyenérték = equivalent, Magyarország = Hungary, Uniós határérték = limit in the EU (KSH, 2015: Figs. 1.1.1, 1.25.2, 1.5.3 and 2.14.1, respectively).**

Unfortunately, the following four diagrams are important to show that some of the goals stated by the UN document are relevant to Hungary, as well (*Figure 3*). One positive trend is that CO<sub>2</sub> emissions are decreasing at a faster pace in Hungary than in the EU as a whole. There are also unfavourable trends, however: the gap between wood production and timber increment is fluctuating instead of widening. Proportional differences in the (taxable) financial income between the richest and poorest 20-20% are ca. 5 times in average for the EU with fairly constant values. In Hungary this proportion is ca. 4 with fluctuating due to the state of economy and the actual political priorities.

## Discussion

Perhaps, the brief description of the energy-related targets is not always easy to understand. Hence, see some readings concerning the most involved topics, i.e. air pollution and climate change.

For air pollution a good comprehension is recently issued by Seinfeld and Pandis (2016) in new edition. For health consequences of high pollution, see WHO (2014). Carbon-dioxide causes not only climate change but also acidification of the oceans (e.g. Fabry et al, 2008). A book with several world-wide maps of occurrence and trajectories has been devoted to the weather extremes (Burt, 2007). Human comfort is often considered in selecting touristic destination (de Freitas, 2003).

Climate change problems are comprehended by the consecutive Assessment Reports (IPCC 2013, 2014a, b, c). Beside them, possible “tipping points”, leading to irreversible changes, have also been established (Lenton et al., 2008). Possibility of these tipping points makes questionable the so called GAIA hypothesis (Lovelock, 1972) postulating the ability of the biosphere to keep the optimal environment around itself: Another global threat, already observed, is the rise of the sea level (Cazenave & Llovel, 2010) most likely inter-connected with the warming of ice packs (Applegate et al, 2015). Behavior of extreme events is projected

by regional climate models of fine resolution in the regions of interest (Jacob et al, 2014). Similar empirical analyses have also been comprehended in connection with climate change by Mika (2013). The most recent source for Europe, based on both models and empirical analyses is issue by the European Environment Agency (EEA, 2017). Financial balance of adaptation in comparison with mitigation of the changes has also been established (Stern, 2006).

## Conclusions

The following innovative contributions have been presented:

- (i) A logical structure of the 17 Goals is provided, which is missing from the SDG (2013-2030).
- (ii) 14 targets from 9 goals of the SDG are selected as related to renewable energy sources. Synergy or conflicting feature of the targets and the renewable energy are stated for a part of the targets.
- (iii) In addition, a few examples of Global and Hungarian sustainability indicators are presented to illustrate some aspects of the selected targets.

As concerns the educational aspects of the presented classification, topical selection and illustration of the targets, three possible ways of using the SDG for teaching *of and by* sustainability have been directly supported. (i) The SDG (2016-2030) are grouped according to the themes of the goals, intending to make them more easily understood and learned. (ii) Comprehending all targets that are directly, or indirectly related to the renewable energy sources, can be used themselves, or serve as an example to perform this selection in any different aspect. Finally, examples for Hungary can be used as examples to perform the same selection to illustrate the national conditions in comparison with the world-wide SDG targets.

The other aspects of using the SDG for education of and by sustainability are not directly supported, but these aspects have been specified in the Introduction.

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Received: *March 16, 2017*

Accepted: *April 28, 2017*

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